GUIDE to Farm Practice in Saskatchewan

1960

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Measures and Weights For Agricultural Purposes

Measuring Grain in a Rectangular Bin

NOTE: One cubic foot is equal to approximately .78 of one bushel.

The number of bushels of grain in a bin may be determined as follows:

1. Level the grain in the bin.

2. Multiply the length of bin by the width by the depth of grain in feet. This gives the cubic content of the bin.

3. Deduct the cubic contents of any studding inside the dimensions taken.

4. Multiply the results by .78. This gives the bushels by measure.

5. Change to bushels by weight by multiplying by the weight of grain per bushel and dividing by the legal weight per bushel.

EXAMPLE: A bin is 12 feet long, 10 feet wide and the grain when levelled is 8 feet deep. It has 18 — 2" x 4" uprights inside of the bin. The wheat weighs 65 pounds per measured bushel.

$(12 \times 10 \times 8) - (18 \times 2 \times 4 \times 8) = 960 - 8 = 952$ c. ft.

$$952 \times \frac{78}{100} = 742.56 \text{ bushels by volume}$$

$$742.56 \times \frac{65}{60} = 804.44 \text{ bushels by weight}$$

Measuring Grain in a Round Bin

The area of floor may be determined by squaring one half of the diameter and multiplying by 22/7.

EXAMPLE: A round bin 12 feet wide contains oats to a depth of 8 feet weighing 40 pounds per bushel.

One half diameter = 6 feet

$$6 \times 6 \times \frac{22}{7} = 113.14 \text{ square feet}$$

$$113.14 \times 8 = 905.12 \text{ cubic feet}$$

$$905.12 \times \frac{78}{100} = 706 \text{ bushels by volume}$$

$$40 \times \frac{706}{34} = 830.5 \text{ bushels by weight.}$$

Measuring Grain in a Cone-Shaped Pile

1. Determine the circumference at the base by measuring (in feet).

2. Multiply this figure by 7/22 to obtain the diameter.

3. Divide this figure by 2 to determine the radius.

4. Determine by measurement the distance (in feet) from the bottom of the pile to the peak = slope.

5. Determine the depth of the pile as follows: Slope squared — radius squared = depth squared. Extract the square root of depth squared = depth.

6. Volume = 1/3 of 22/7 × radius squared × depth.

7. To change volume from cubic feet to bushels by measure multiply by 78 and divide by 100.

8. Adjust to bushels by weight as previously explained.

Measuring Hay and Straw in Stacks

The approximate number of tons of hay or straw in a stack may be determined as follows:

1. Estimate the number of cubic feet in the stack.

2. Determine the number of tons in the stack by dividing the number of cubic feet in the stack by the number of cubic feet per ton as follows:

(a) Alfalfa, sweet clover and wild hay.

Days in Stack	Cubic feet per ton
30	548
60	520
90	504
120	492
150	480
180	472
240	456
300	440

(b) Brome Grass Hay.

Allow about 25 percent more cubic feet per ton than in (a) above.

(c) Straw.

It requires at least 1200 cubic feet of well settled straw to weigh one ton.

Legal Bushel Weights of Saskatchewan Crops

	lbs.
Wheat, alfalfa seed, clover seed, beans, peas, potatoes	60
Rye, flax seed, corn	56
Rapeseed	50
Barley, buckwheat, timothy seed	48
Hemp seed	44
Oats	34
Crested wheatgrass seed	22
Brome grass and western rye grass seed	14
Bluegrass	18

Measures and Conversion Factors

1 link = 7.92 inches
1 rod = 25 links = 5½ yards = 16½ feet
1 chain = 100 links = 66 feet
1 mile = 80 chains
1 square rod = 30¼ square yards
1 acre = 160 square rods = 4840 square yards
1 square mile = 640 acres
1 peck = 2 gallons = 8 quarts = 16 pints
1 bushel = 4 pecks = 8 gallons
1 imperial gallon = 1.25 (5/4) U.S. gallons
1 cubic foot = 6.23 gallons
1 bushel = 1.28 cubic feet
1 cubic foot = 0.78 bushel
1 cubic foot water = 62.5 pounds
1 gallon water = approximately 10 pounds

Guide to Farm Practice in Saskatchewan

Prepared jointly by representatives

of the

UNIVERSITY OF SASKATCHEWAN

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and the

EXPERIMENTAL FARMS, RESEARCH LABORATORIES AND OTHER SERVICES OF THE CANADA DEPARTMENT OF AGRICULTURE IN SASKATCHEWAN

1960

Prepared for

SASKATCHEWAN'S FARMERS, HOMEMAKERS AND RURAL YOUTH

upon whose industry, good husbandry and good citizenship rests the success and permanence of Saskatchewan agriculture.

Obtainable from

DEPARTMENT OF EXTENSION, UNIVERSITY OF SASKATCHEWAN
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Foreword

FOR years a wealth of agricultural information based on research, experimentation and practice had been available from many sources in Saskatchewan, but not until 1928 was a definite attempt made to co-ordinate and consolidate this information and put it into readily usable form for the benefit of farmers. In that year, representatives of the University of Saskatchewan, the Saskatchewan Department of Agriculture and the Federal Experimental Farm System in Saskatchewan met in conference and prepared and presented practical reports and recommendations on the major problems of crop production in this province. These recommendations were then made available for Saskatchewan farmers.

The benefits accruing from this conference were such as to prompt the decision that it be held periodically, and it became known as the "Agronomy Conference", the reports submitted being published and distributed widely as a bulletin entitled "Guide to Crop Production in Saskatchewan".

In 1932 a comprehensive plan was drafted by the Minister of Agriculture for Canada to co-ordinate on a national scale all Dominion and Provincial government services available for farmers. The plan involved a National Advisory Committee and a co-operating Advisory Committee in each province. The Saskatchewan Advisory Committee was named early in 1933 and the Agricultural Conference in January of that year was held under the direction of this Committee. Under the new plan the Conference dealt with every phase of agricultural production, and the 1933 report went out under the broader title "Guide to Saskatchewan Agriculture".

Agricultural conferences have since been held in January, 1936; 1939; March, 1942, 1945, 1948, 1951, 1954, December 1956 and 1959. On each occasion the resulting "Guide" has presented a revision of the previous material and has contained as well, new information which it was considered would add to the usefulness of the publication. In the preparation of the 1939 Guide so much general agricultural information of merit was presented that it was considered expedient, to keep the publication within reasonable limits, to include material on farm practices only and in furtherance of this policy the title of the publication was changed to "Guide to Farm Practice in Saskatchewan". The subsequent Guides have been published under this title.

As before, the Guide represents the pooled findings and recommendations of the technical workers in Agriculture in Saskatchewan on the basis of information available in 1959. **Since the publication is issued to cover a three-year period the reader should realize that for subsequent years the recommendations given herein may change.**

The publication of the Guide is financed jointly by the Canada and Saskatchewan Departments of Agriculture.

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Guides Published

March	1933	12,000 copies
May	1936	27,500 copies
April	1939	35,000 copies
June	1942	35,000 copies
October	1945	50,000 copies
October	1948	50,000 copies
October	1951	50,000 copies
October	1954	50,000 copies
March	1957	60,000 copies
March	1960	60,000 copies

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CLIMATE*

General Characteristics.—The seasonal weather of Saskatchewan is determined largely by the relative frequencies of invasion of three different types of air masses. Polar Continental air (PC) comes from the region between Alaska and Hudson Bay; Polar Maritime air (PM) from the northern part of the Pacific Ocean, and Tropical Maritime air (TM) generally from the Gulf of Mexico and the sub-tropical latitudes of the Atlantic Ocean. Each air mass, while over its source region, acquires certain physical properties. PC-air is cold, dry and stable, the stability resulting from the greater cooling of the layers of air next the ground than of those at higher levels. PM-air is cool, moist and comparatively stable. TM-air is warm, moist and generally unstable. As each air mass moves from its source region the characteristic properties, particularly in the lower layers, are changed by the land and water surfaces over which it passes. Cool air in passing over a warmer surface is heated and tends to become unstable; warm air in passing over a colder surface is cooled and tends to become stable. Dry air, if it is becoming unstable, evaporates moisture from the surface and thus becomes moist; warm moist air, if it is becoming unstable, is subject to thunderstorms and thus loses moisture.

Winter invasions of Saskatchewan by PC-air are responsible for the cold waves when temperatures often drop to values as low as —50°F. On the other hand, invasions of PM-air in winter are responsible for the mild periods when temperatures may rise sufficiently to melt the snow. Neither brings much moisture, but PC-air because it is inherently dry, and the PM-air because it loses its moisture in crossing the Rockies. Whether a winter is exceptionally cold or mild depends on the persistence of the invasions of the one type or the other. In the summer months the PC-air on reaching southern Saskatchewan is becoming unstable, and as a result evaporates far more moisture than the accompanying low temperatures suggest. The clear skies and the relatively low moisture content of this air mass make possible the radiation of much heat from the surface during the night, the temperature sometimes dropping to below the freezing point. Occasionally PM-air on reaching the Prairies in spring and early summer is becoming unstable. This tendency along with its dryness leads to severe dust storms. The instability helps to lift small soil particles into the atmosphere where they are carried forward at relatively high velocities by the wind and driven against the surface of the soil, breaking loose many more particles that are lifted in turn and carried forward by the wind.

Precipitation on the Prairies is dependent on the arrival of warm, moist air masses from the South. During the summer months the prevailing wind directions favor the transport of TM-air into the interior of North America and as far north as Saskatchewan. Generally TM-air is stable when it reaches Saskatchewan, little precipitation of the convectional or thunderstorm type occurring within the air masses. For a widespread rainfall colder and thus denser PC-air must push southward underneath the TM-air, or warmer and thus lighter TM-air must push northward over PC-air. In either case the TM-air is lifted, the lift causing the air to cool to temperatures suitable for the condensation of its moisture. Many of the severe droughts over the Prairies have resulted not from a lack of air with an ample store of moisture but from a failure of PC-air to push southward to give the necessary lift.

Climatic Records.—Tables giving average and extreme temperatures, average and extreme humidity, sunshine, precipitation, and wind speed and direction for many places in Saskatchewan can be found in Volumes I and II of Climatic Summaries for Selected Meteorological Stations in Canada. A third volume on frost data has just been published. These can be obtained from the Meteorological Office, Toronto, at a nominal cost. A Climatological Atlas of Canada has been prepared by M. K. Thomas for the Division of Building Research, National Research Council. This contains many maps showing distributions of temperature, rainfall, snowfall, days with rain and snow and other climatic elements of interest to agriculturists. A paper-bound copy can be purchased from the National Research Council, Ottawa, or the Meteorological Office, Toronto, for $2.00. A volume, entitled The Climate of Central Canada and prepared by W. G. Kendrew and B. W. Currie is avail-

*Prepared by Department of Physics, University of Saskatchewan.

able from the Queen's Printer, Ottawa, for $1.00. This contains descriptions of the climatic characteristics of the Prairie Provinces and the Northwest Territories as well as numerous maps and tables.

Precipitation.—Much detailed data on monthly and annual precipitations are given in the Bulletin, "Rainfall Records for Saskatchewan," which can be obtained from the Extension Department, University of Saskatchewan. A map, taken from this Bulletin, is included with this summary, and shows the average precipitation from April 1 to November 1. The precipitation during the balance of the year is mostly in the form of snow, and in terms of precipitated water amounts to about one-fifth of the values shown on the map. For the Province as a whole, about 11 years out of 20 have rainfalls less than the yearly average. This is because a few years with exceptionally heavy falls raise the average value somewhat higher than the observed values for one-half of the years. Alternately, the median precipitations or precipitations for which one-half of the years of record will have higher and the other half lower values, are about one inch lower than the average precipitation shown on the accompanying map.

In most years snowfall is of little value in the production of grain crops. Winds remove much of the snow from cultivated fields. The water from the remainder runs off over the frozen ground in the spring. Excellent crops result only when ample rainfall coincides with the long hours of sunlight and the high temperatures of summer. Attempts have been made to catch and to hold drift-snow by ridging the snow. Considerable success may be anticipated on stubble land and on fields used for hay and pasture. In both cases considerable snow will lodge and be available for ridging, and in spring the run-off will be less than on summer-fallow. In any case, the ridges should run north and south, partly because the prevailing winds are from the west and partly because the snow in east-west ridges melts quickly during a warm spell.

Hail Storms and Tornadoes.—Hail storms occur more frequently during summers with heavy rainfall since similar atmospheric conditions tend to produce both. Such storms usually start in the late afternoon and travel eastward, often until late at night or early in the following morning. The path of greatest destruction is seldom more than four to six miles wide, but may be several hundred miles long. The storms may occur at any time during the growing season, but are seldom very violent except in the last week of June, all of July and the first two weeks of August. The region lying south of the main line of the Canadian Pacific Railway and eastward from the Cypress Hills experiences such storms with greater frequency than other parts of the Province. The northeast and east-central positions suffer the least damage.

Tornadoes are apparently more frequent than was at first supposed. Their paths are narrow and short so that the probability of damage to buildings is small. Only two cases are known where such storms have struck places of considerable size, namely, Regina in 1912 and Kamsack in 1944. Occasionally the reported damage to farm property leaves little doubt that a whirling storm of the tornado type was responsible.

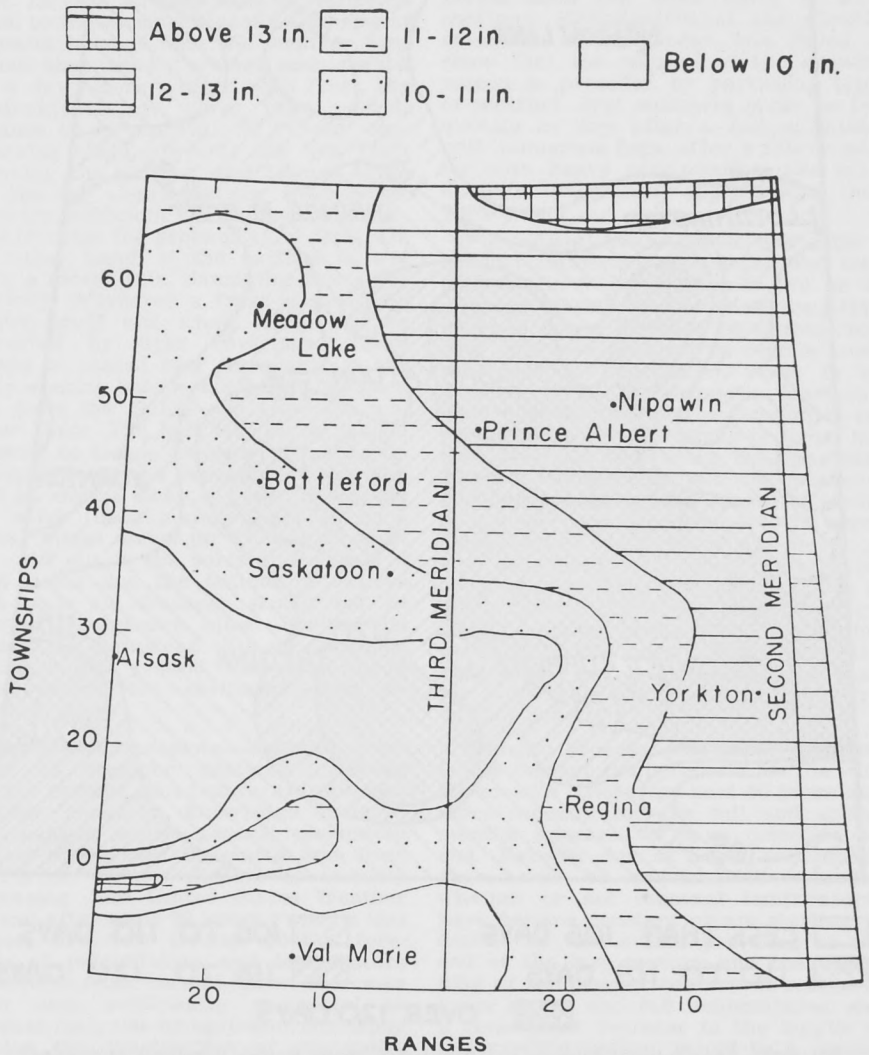
Frost.—The period in days between the last killing frost of spring (29°F.) and the first killing frost of fall is shown on the accompanying map. This period is about two weeks longer, than the period between the last frost of Spring (32°F.) and the first frost of fall. The former period is significant for grain crops, the latter for small fruits and tender garden suff. Actually the frost free period at any particular spot is very dependent on the topography. The cold air from the high land and the slopes drains into the low spots, and these may have frost in every month during the year.

The average date of the last spring frost (32°F.) is approximately June 1, for the eastern portion of the Province from the Churchill River south to the United States boundary; June 7, for the northwestern portion from the main line of the Canadian National Railway to the height of land between the Saskatchewan and Churchill drainage basins, and for the Cypress Hills country; and May 27, for the remainder of the grain-growing area. For most of this region the last frost has occurred as early as April and as late as July. Fifty percent of the last frosts have occurred within a period of about 18 days centered on the aforementioned dates.

The average date of the first frost of fall (32°F.) varies from August 28, for the Cypress Hills and the northwestern region, to September 9, for the northeastern region between the Saskatchewan and Churchill rivers. The

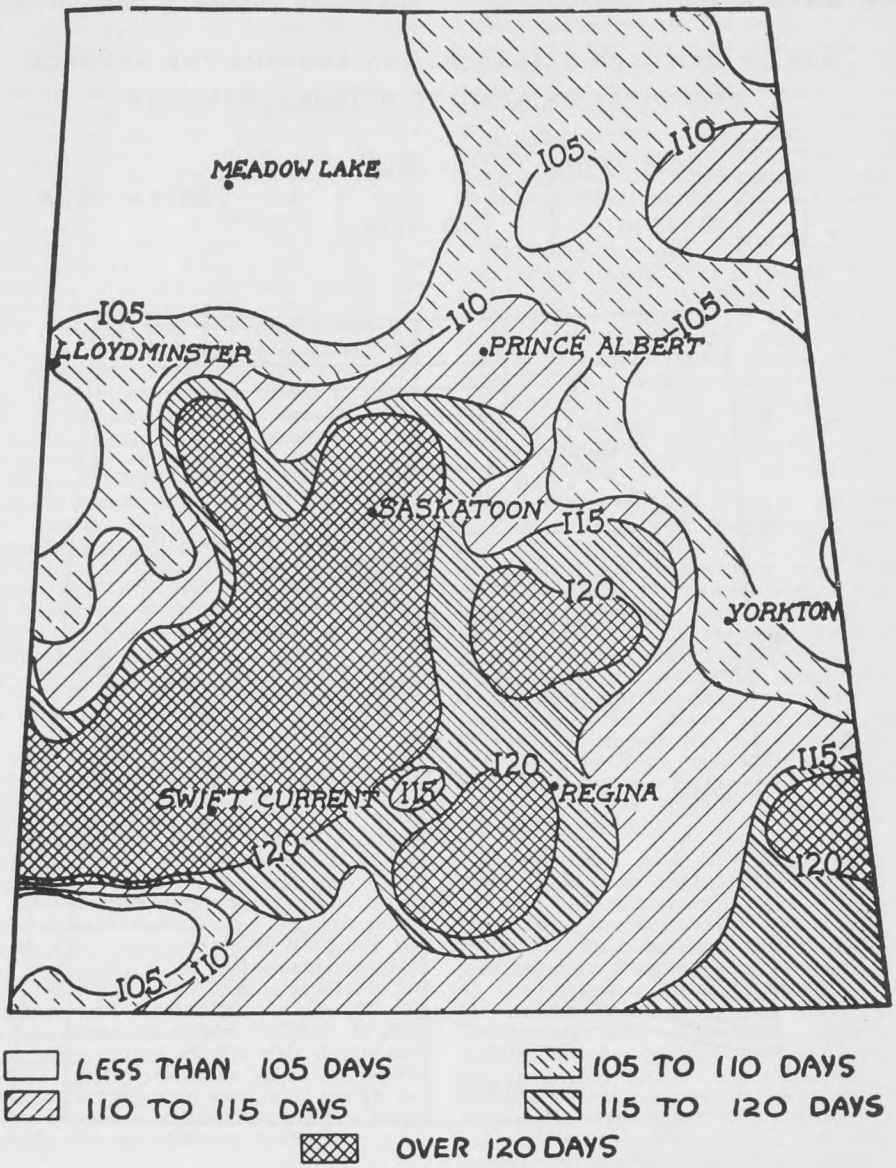
later occurrence in the northeast is due partly to the decrease of altitude and lakes and ponds, both of which lengthen the frost-free season. For practically all of the settled region of the Province the first fall frost has occurred as early as the first week of August and as late as October. Fifty percent of

MAP OF SOUTHERN SASKATCHEWAN SHOWING THE AVERAGE PRECIPITATION APRIL TO OCTOBER INCLUSIVE



This map is from Bulletin No. 18, "Rainfall Records for Saskatchewan," published by the Extension Department, University of Saskatchewan, and outlines the districts where the average precipitation from April to October is similar. Roughly, the precipitation zones are diagonal across the southern part of the Province. There is an area of increased precipitation in the southwest where the Cypress Hills rise about 1000 feet above the surrounding country. From this area there extends northward a belt of more favorable rainfall than that prevailing in the surrounding districts. The area of highest precipitation is in eastern Saskatchewan with the maximum centering in the vicinity of Qu'Appelle. It is possible that small areas within each precipitation zone may, due to local conditions, have rainfall higher or lower on the average than that shown in the above map.

AVERAGE LENGTH OF PERIOD IN DAYS BETWEEN THE LAST KILLING FROST OF SPRING (29° FAHR.) AND THE FIRST KILLING FROST OF FALL



SOURCE—"Agriculture, Climate and Population of the Prairie Provinces of Canada"
A Statistical Atlas by the Dominion Bureau of Statistics, 1931

There are many local variations in the duration of the period from the last killing frost in the spring to the first in the fall, but in general this period is ten days to two weeks shorter in the northern part of the settled area of Saskatchewan than in the south. On the plains in southern districts killing frosts are usually over about 15th of May. The last killing frost occurs on an average about two weeks later in eastern Saskatchewan following a range of hills and in northwestern Saskatchewan in the hilly territory about the creeks flowing into the North Saskatchewan River.

the first frosts happen within a period of about 20 days centered on the previously mentioned dates.

The Dominion Weather Service now issues very reliable warnings of late spring frosts and early fall frosts. These are included in the radio TV broadcasts of weather at times when frost is imminent. In case an individual is unable to listen to the weather forecasts, he should acquaint himself with the weather conditions that usually precede such events. On a day before a night with frost, the temperatures are lower than normal because of an outbreak of PC-air; considerable cloud prevents the sun from warming the surface; and toward evening the sky clears and the wind drops. Showers sufficient to dampen the surface increase the probability of frost. On the other hand, if the surface is wet from a recent rain, damaging frosts are unlikely. Whenever a frost is probable, garden stuff and small fruits can be protected by light coverings. These should be placed over the plants in the early evening before much heat has been lost from the plants and from the soil below them. The best site for a garden in order to escape damage from frost, is a slope facing the prevailing wind. The cold air drains away to lower levels and the wind (usually very light in such cases) mixes warm air from aloft with the cold air at the surface. Hollows in level fields and the bottom of valleys with poor air drainage should not be selected as garden sites. Shelterbelts around the farmstead with an open side toward higher ground allow cold air to drain inside the shelterbelt and be trapped there.

Seasonal Forecasting.—Reliable forecasts of weather patterns covering several months in advance are still not possible. However, knowledge concerning changes in the general circulation of the winds over the earth and their effects on future weather is steadily increasing. The United States Weather Bureau after some 20 years work on this subject are now issuing 30-day forecasts of precipitation and temperature departures from normal. These forecasts have been sufficiently successful to warrant their use by agriculturists. They involve the construction of prognostic maps of precipitation and temperature for all the Northern Hemisphere. A pamphlet containing these maps and giving a resume of the weather for the past month and the outlook for the coming month is issued on the first of each month. It can be obtained by an annual subscription of $4.80, paid in advance to the Treasurer of the United States and sent to the Superintendent of Documents, Government Printing Office, Washington, D.C.

The tendency for a particular weather type to persist is sometimes overlooked. Contrary to popular opinion the longer a dry period or a wet period or a cold period lasts the more likely it is to continue. Examination of the climatic data for Saskatchewan has failed to show that the rainfall of the growing season is preceded by particular types of weather. Wet summers occur as frequently as dry after a fall or winter with numerous fogs, after a fall or winter with heavy precipitation, and after a winter with lower than normal temperatures.

For several years before and after a sunspot maximum the rainfall and temperature in Western Canada are on an average slightly below their long-time average values. Notable exceptions from this rule have occurred in certain localities and for particular years in all localities. The last sunspot maximum was in 1958. The next maximum is expected in about 1969. Some progress has been made in predicting the time that either a sunspot maximum or minimum will occur, although the length of a sunspot cycle may vary from 9 to 14 years. Variations of temperature and precipitation associated with sunspots are small in comparison with the variations due to other causes. While the sunspot effects should be taken into account in planning farm operations over a period of years, they should not be considered the basis for large-scale changes in normal agriculture practices.

Climatic Trends.—The steady increase in the average temperatures for the winter months during the past 50 years and more recently for the fall and spring months appears to have come to an end. Records for at least another 10 years will be required to establish whether or not seasonal temperatures have become constant or are starting to decline to values that prevailed at the end of the last century and the beginning of the present century. A return to lower spring and fall temperatures, and a consequent decrease in the length of the growing season, would be a matter of some concern along the northern limits of the regions presently under cultivation. Crops now critically dependent on the length of the frost-free season and the heat available for growth would no longer be grown successfully until earlier-maturing varieties could be discovered.

Considerable publicity has been given in the newspapers to the effects of carbon dioxide and the debris from nuclear explosions on weather and climate. Neither appear to be a matter for immediate concern. Carbon dioxide is being added to the atmosphere in ever increasing quantities from the exhausts of motor cars and the smoke-stacks of factories. It is also absorbed from the air by the oceans. The net increase is still too small to result in any marked rise of temperature. Conceivably, several hundreds of years from now (assuming that the rate at which carbon dioxide is added keeps increasing), the effect on temperature may be both recognizable and significant. Large nuclear explosions project very fine particles of matter, (some radioactive,) high into the atmosphere where they are dispersed by the winds. Weeks and even months are required for them to settle back to the earth's surface. Reputable meteorologists have stated that the number of particles at the present level of nuclear tests is far too small to have any significant effect on weather or climate. The suggestion that abnormal hot and cold spells, and floods and drouths of recent years are related in some way to the nuclear tests has no scientific basis. Their intensities have been well within the probable limits established by existing weather data. Often the loss of life and property has been due to failures to make use of these limits in establishing communities and in settling particular areas. Frequently, artificial conditions are created that amplify the effects of an abnormal weather situation. A well-known one is the paving of streets and lanes in small cities without providing additional storm sewers to take care of the rapid run-off.

Moisture conditions have been less favourable during the past two or three years. This may have been due to the sunspot cycle (mentioned previously). Drouthy conditions may occur during the next two years as the minimum in the sunspot cycle is approached. By 1963 moisture conditions should be normal for the Prairie Provinces.

Weather Modification. — Artificial methods of increasing rainfall and suppressing hail storms are still the subject of much discussion and experimentation. Laboratory tests and trials on particular clouds have shown beyond all question that either small pellets of carbon dioxide (dry ice) or silver iodide crystals will induce the formation of raindrops in a cloud. The first acts by cooling the air close to the falling pellets to a temperature where ice crystals form on the sublimation nuclei occurring naturally in the atmosphere, (particles on which water-molecules collect directly to form ice); the second by serving as sublimation nuclei at air temperatures appreciably higher than are required for the natural nuclei to be effective. The ice particles, once formed, act as centres for the formation of raindrops. In this way, raindrops can be formed either at lower levels in a cloud or before the cloud has grown in height to levels where the ordinary atmospheric temperatures cause the formation of ice particles and eventually of raindrops. Also, by using large quantities of dry ice or silver iodide it is believed that many small raindrops can be formed,—thus decreasing the possibility of a situation leading to destructive hail storms. While the presence of ice particles in a cloud appears to be an important factor in converting cloud particles to raindrops, particularly in temperate and high latitudes, it is not an essential factor. Much of the rain of tropical latitudes falls from clouds at levels where air temperatures are above the freezing point for water. Apparently, the rains of tropical latitudes result from collisions between cloud particles of different sizes, and between cloud particles and the raindrops.

Earlier ideas that rainfall could be increased by "triggering off" clouds with dry ice or silver iodide have fallen into disrepute. A cloud to produce an appreciable amount of rain must be fed by a continuous stream of air which is loaded with water vapour. Most clouds are not of the type that produces rain. Raindrops can be formed in them by artificial methods; but the fall is small, the drops often evaporating before they reach the ground. Occasions when potential rain clouds exist and rain does not occur eventually from them are rare. Even so, the possibility exists that the precipitation process might be started a little sooner in these clouds; thus giving rain to an area that might not otherwise get it.

Present practices consist of trying to increase the rainfall from a rain-producing cloud. If ice crystals are the most important agent, (or the only agent leading to raindrop formation), there is a very considerable volume of cloud at lower levels in which raindrops do not form. By adding silver iodide crystals to the cloud, ice crystals can be formed at lower levels and thus raindrops in a greater volume of the cloud. It is argued that this should lead to a greater fall of

rain than would otherwise occur. Since the rain results from a dynamic process, (continuous additions of moist air from the surface), no particular region is likely to experience a loss of rain because others get larger rains by this means.

Verification that the rainfall is actually increased by the aforementioned procedures is extremely difficult. Commercial firms conducting these operations have gathered much data indicating that these procedures are successful. A statistical comparison by the Meteorological Service of Canada of the rainfalls within and outside the "seeded" area for one season's operation in Central Saskatchewan indicated that the rainfall was decreased rather than increased. Actually, the rainfalls for semi-arid regions vary by such large amounts within comparatively short distances that it is doubtful if a reliable conclusion can be reached on the observed falls at a few places and for only one season. Most meteorologists agree that several seasons of operation are necessary; also that the most conclusive tests would require "seeding" patterns characterized by variations with time or area that could be easily recognized in the resulting rain.

The most convenient procedure for "seeding" is to vaporize silver iodide by burners placed in strategic positions relative to the air currents feeding the rain clouds. The crystals are assumed to be carried upward by the air currents, and to reach cloud levels over the area where the rain is to be increased. There are many incidental problems. The best locations for the burners and the times when the burners should be placed in operation are ones depending on a close liaison between the operators and a competent meteorological service. Others concern the extent and rapidity with which the silver iodide crystals are dispersed from a burner located on the ground, the period of time during which the silver iodide crystals retain their effectiveness, the effect of air temperature and light on the crystals, and the temperature at which the silver iodide should be evaporated. These are still the subject of much investigation. Reliable experimental methods for testing some of these points are still to be discovered. Some recent laboratory experiments indicate that the period of time for which the silver iodide crystals retain their effectiveness as sublimation nuclei depends on the method by which they are prepared. This may explain the apparent success of some "seeding" programs and the lack of success in others.

Tests on the effectiveness of silver iodide "seeding" in suppressing hail storms were started by the Alberta Research Council during the summer of 1956. A small region with a history of severe annual damage from hail was selected. The tests have not been conclusive. The areas in which they were carried out experienced few hail storms. The tests are being continued.

One should not be too pessimistic about the future of weather modifications. Cloud physics is a relatively new field. Only by patient research and the development of new techniques for following the development of raindrops in clouds will it be possible to discover procedures by which rainfall and storms in selected areas and at particular times can be modified by artificial methods.

* * *

SOME COMMON WHITEWASH FORMULAE

A. 1. Dissolve fifteen pounds of common salt in seven and one-half gallons of water.
2. Slowly add one sack of hydrated lime, **stirring vigorously.**
3. Thin this to a milk like consistency with water.

B. 1. Make a cream of one sack hydrated lime and eight gallons of water.
2. Slowly add one quart of crude carbolic acid, stirring vigorously. The quantity of acid may be doubled if desired
3. Thin to a milk-like consistency.

C. 1. Make a cream of one sack hydrated lime and seven gallons of water.
2. Dissolve six pounds of salt in three gallons of boiling water.
3. Mix (1) and (2) when cold.
4. Stir three pounds of Portland cement into (3).
One gallon will cover approximately 225 square feet.

SOILS AND FERTILIZERS

The productive soil is a thin layer of the earth's surface. The most fertile top soil is only a few inches thick and the total depth of the soil is rarely more than a few feet. These facts emphasize the need for good soil management to maintain the soil in a fertile state and obtain the maximum production of the desired crops. This objective can only be achieved if adequate attention is given to the maintenance, or improvement, of the **structure** and **fertility** of the soil, to the **conservation of moisture** and to the prevention of losses of valuable top soil by **wind and water erosion.**

Proper granulation, or good soil tilth, is of prime importance to soil productivity. It is essential for the ready penetration of plant roots, for good soil aeration, and for maximum storage of rain water. Adequate tilth (or good structure) also ensures better control of wind and water erosion.

Soil fertility is determined by the supply of plant foods available in the soil. The need for maintaining soil fertility is emphasized by the fact that—**if only one of the 16 essential plant nutrients is not available in sufficient quantity,** yields will be lowered even if all other conditions affecting the growth of plants are entirely satisfactory.

The loss of soil fertility through wind or water erosion is more serious than is depletion caused by cropping or grazing. A depleted soil can be improved by good husbandry. An eroded soil may be so badly damaged that complete reclamation is next to impossible. It is the fertile top soil which is lost by wind and water erosion. The sifting action of the wind, or the sorting action of running water, causes a progressive loss of the rich clay and humus of the soil and the soil becomes sandier textured. The whole result is to lower the soil's general fertility and water absorption capacity, which increases the likelihood of further erosion. **Wind or water erosion may permanently damage the land.**

Soils are very variable in their nature, and management practices as well as kinds of crops and crop rotations must be varied according to the character of the soil and its climatic location. Soils may vary widely in humus content, depending on the climate and vegetation within the region in which they have developed. The soil zonal map (page 11) illustrates in a general way the relationship of climate, vegetation and the zonal soils of Saskatchewan. Within each zonal area the soils may be sandy, loamy or clayey in texture, depending on the nature of the geological materials from which they were formed. They may also vary widely in the chemical and physical nature of the topsoil and subsoil, depending on the local conditions of slope and drainage associated with any one kind of geological material. More detailed information about the types of soil in particular areas may be obtained from the University of Saskatchewan, Saskatoon. The following sections deal with some of the more important soil problems in Saskatchewan.

SOIL ORGANIC MATTER AND HUMUS

The best conditions of structure, tilth and moisture storage can only be maintained if the supplies of humus, or partially decayed plant and animal matter, are adequate and are continually replenished by additions of fresh organic matter (straw, manure or green manures) which is allowed to decay. Humus also serves as a storehouse for food for the organisms which live in the soil. The processes of decay are essential for the continuing supply of certain plant nutrients as well as the maintenance of soil tilth. Fresh organic matter also decomposes to form granulating materials which greatly improve the soil's ability to absorb and store moisture. **Best crop yields can only be obtained through proper attention to the supply of organic matter along with other proven production practices.**

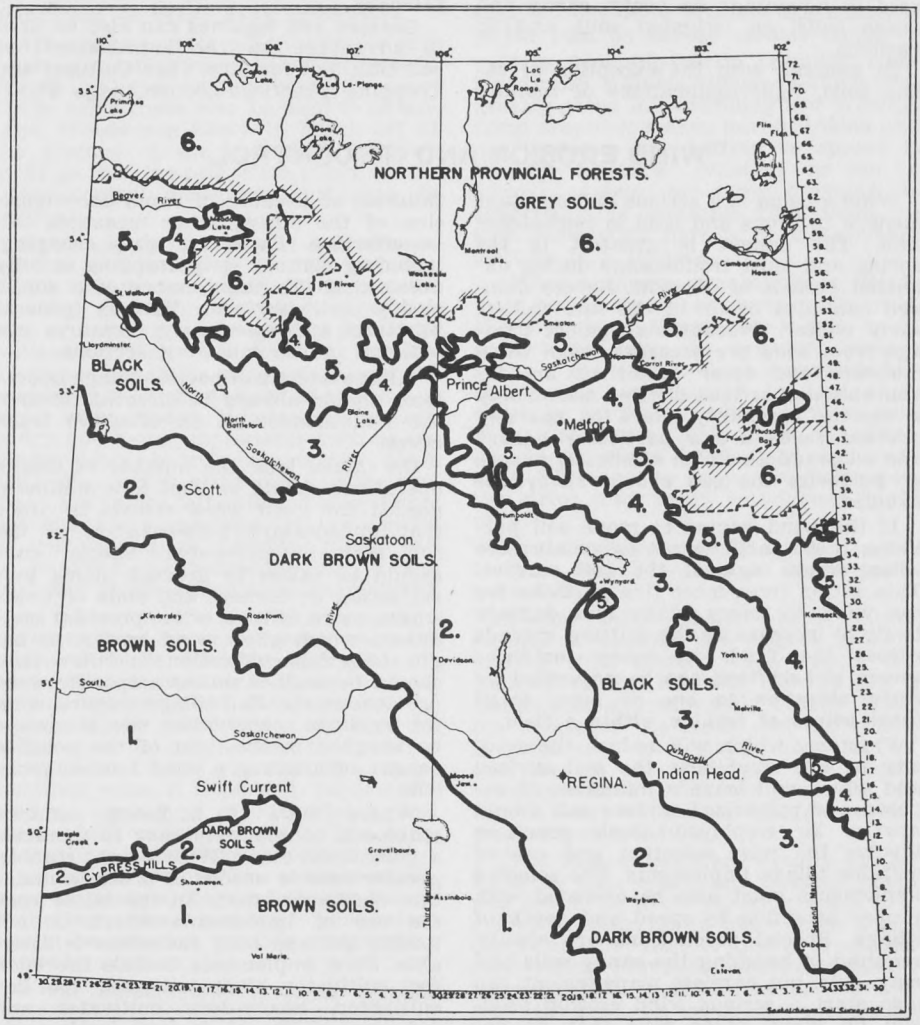
Straw should not be burned—it is a valuable source of fresh organic matter and also provides food for certain microbes which play an important role in adding nitrogen to the soil from the air. The return of straw and stubble to the soil provides immediate protection against wind and water erosion and, over a longer period, assists in meeting the problems of maintaining the soil in a highly productive state.

Farm manure—the organic matter of farm manure also adds to the humus content of the soil, improves the moisture properties and tilth and also stimulates greater activity amongst the microbes. It is also a very valuable

complete fertilizer. Manure contains, on the average, 10 pounds of nitrogen, 5 pounds of phosphate and 10 pounds of potash per ton. The large amounts of manure generally used compensate for its relatively low nutrient content.

Manure should be applied where the greatest benefits will result. On light colored knolls, manure will help to reduce erosion, will increase yields and

THE SOIL ZONES OF SASKATCHEWAN



LEGEND

1. Brown Soils of the open prairie, the most arid section of the province. Wide variations in crop yields and frequent severe droughts.
2. Dark Brown Soils of the prairie, less arid than the Brown Soils. Variable crop yields but less frequent severe droughts.
3. Black Soils of the parkland. Better moisture conditions and better average yields than on the prairie. Severe droughts rarely experienced.
4. Deep Black and Greyish Black Soils of the parkland-forest belt. Good moisture conditions and high crop yields.
5. Grey Wooded Soils of the forest region. Moisture conditions good, but soils are low in organic matter and general fertility.
6. Grey Soils and Muskeg of the unsettled Northern Provincial Forest.

- - - - Boundary of Northern Provincial Forest Reserves.

give better uniformity of crop. Application of manure improves the structure and fertility of the greyish "bluff podzol" spots found in the black and greyish black soil areas. Pastures are usually benefitted by light applications, and alfalfa fields also respond, particularly on grey wooded soils. Manure can also be used to advantage on peaty, sandy and saline soils, on irrigated soils and on gardens.

In general, with the exception of saline soils, light applications of manure are advisable, 10 or 12 tons per acre being sufficient. This allows coverage of a greater area and avoids excessive drying out of the soil. In the case of saline soils, much heavier applications are desirable, perhaps double the above rate. **Manure is best applied directly from the barn or feed lot on land that is to be fallowed.**

Grasses and legumes can also be used to advantage for the improvement of soil tilth and fertility. (See Cultural and Cropping Practices section, page 31.)

WIND EROSION AND ITS CONTROL

Wind erosion is a serious and constant menace to crops and land in Saskatchewan. The danger is greatest in the spring and most troublesome during extended periods of drought. Severe damage can also occur in the late fall or early winter. **Precautions against damage from wind are necessary even when moisture and other conditions are favourable and serious drifting seems only a remote possibility. Bare or sparsely covered fields are a particular hazard and all practices which needlessly expose or pulverize the soil should always be avoided.**

If the wind begins to move soil particles, these particles act as an abrasive when driven against the soil surface. This action frees more fine particles for the wind to carry along and damage tends to increase as the drifting spreads across the field. **In many instances severe soil drifting can be prevented by early attention to one or more small focal points of trouble within a field.**

Practices which will reduce the velocity of the wind near the soil surface and which will leave a minimum of exposed and pulverized surface soil should always be employed. Such practices involve the wise selection and use of suitable tillage implements. The selected implements must also be operated with proper attention to speed and depth of tillage. Special precautions are always required in handling the sandy soils and clay soils, but careless management can also start a serious wind erosion problem on many other soils that do not tend to be pulverized as readily.

Stubble and straw should not be burned. A good standing stubble will reduce the velocity of the wind to the point where no soil drifting can occur. The best method of preventing wind erosion on summerfallow land is to maintain a good trash cover at the soil surface. In areas where a trash cover cannot be maintained because of crop failures, or because of rapid decomposition of the straw, other measures can be effective. These are strip cropping, including contour strip cropping in hilly areas, and the maintenance of a rough cloddy soil surface. Various general practices and emergency measures are outlined in the following sections.

Tillage and trash cover—tillage operations should always be directed towards the maintenance of an effective trash cover.

On fallow land the number of tillage operations should be kept to a minimum needed for good weed control in order that unnecessary pulverization of the soil may be prevented. Special care should be taken to prevent undue pulverization at corners and ends of fields where extra tillage often provides conditions which allow wind erosion to begin. Late fall cultivation on fallow land should be avoided unless a specific weed problem exists. Fall tillage requirements for moisture conservation should always be weighed in the light of the possible danger of creating a wind erosion problem.

Where there is a heavy combine stubble it is relatively easy to maintain a good trash cover. With a light stubble, greater care is needed in order to maintain sufficient trash. In the latter case the use of implements which do not readily cut and bury the straw is desirable. Such implements include the duck foot cultivator, blade cultivator, tool bar cultivator, heavy-duty cultivator and rod weeder. The blade type implements are also particularly effective on the sandy and loamy soils of the Brown and Dark Brown soil zones.

Repeated use of disc type implements will cut and bury the straw, thus hastening its decay and reducing its effects as a protective cover for the soil. Furthermore, disc type implements are more likely to pulverize the soil when it is relatively dry, thereby increasing the

danger of wind erosion. **Disc type implements should always be used with considerable care. Experiments conducted at the Lethbridge Experimental Farm have shown that up to 75 percent of the straw and stubble is buried after two operations of the oneway disc, whereas only 30 to 40 percent is buried after two or three operations with the blade type or heavy duty cultivators.**

After a poor crop, practically the only trash available may be from weeds. Weeds make a very poor trash cover but in some cases may be used to advantage. Weeds are likely to break off at the surface of the soil and be blown away so that the protective effect is lost. Other control measures must then be adopted.

Early spring is the most critical period for soil drifting on fallow lands. Fields which have drifted during the late fall or winter, or which show any sign of drifting in the spring, should be worked as early as possible. Shallow discing is generally quite effective if the surface soil is crusted, or if the soil is moist when disced. However, if the soil is dry and loose, implements such as the spring tooth harrow or narrow tooth cultivator, which bring clods to the surface, are more effective. These latter operations are specially for the control of drifting and some further tillage will be required just before seeding to destroy any weeds which have germinated.

On loam soils the plow can be used to advantage **as an emergency measure where there is insufficient stubble to maintain a trash cover.** However, it is very important that weed growth be controlled by cultivation during the early part of the season to conserve moisture and have the soil in a moist condition when it is plowed. Implements such as some type of cultivator or rod weeder are satisfactory for this early cultivation. Late plowing (during July) is preferable because less subsequent tillage is required to control the weeds. Following the plowing, cultivation should be directed towards maintaining a cloddy surface.

If the stubble land is to be cropped rather than fallowed, a heavy residue of straw and stubble may be considered troublesome. First, there is the difficulty of preparing a good seed bed and, second, a shortage of nitrogen may occur especially where the straw and stubble are cut up and worked in to seed depth. These difficulties can be partly overcome by spreading the straw well with such implements as the oscillating harrow, and by working shallow so that the least amount of straw is worked in to seed depth. Packing after the seeding operation is essential. The use of a nitrogen-phosphate fertilizer will help to overcome the fertility deficiencies in those areas for which this practice is recommended. (See fertilizer recommendations.) **Burning the stubble and straw may seem to provide the simplest solution but wind erosion has occurred in the past on burned stubble lands.**

Strip Cropping—Strip cropping combined with suitable tillage methods will greatly assist in controlling soil drifting. Strip cropping means narrow fields and the tendency for drifting to spread is thereby lessened. Whether or not a formal system of strip cropping is adopted it is desirable that fields be kept reasonably narrow in areas where drifting is a menace.

Under ordinary circumstances, strips may be as much as forty rods wide. However, when the stubble is thin, or on soils very liable to drifting, narrow strips are desirable. Summerfallow strips may be reduced to half their width by seeding a narrow strip of oats down the centre. This gives, in effect, two 20-rod strips in place of one of 40 rods. When better crops are harvested, the strips may again be widened to 40 rods.

In areas where sawfly control is necessary, consult section on insect pests, page 114.

Shelter Belts—Shelter belts, either natural or planted, are helpful in combatting wind erosion. They reduce the velocity of the wind to leeward for a distance of approximately twenty times the height of the trees, and also for a distance of 6 to 8 times the height of the trees to the windward side. Moreover, increased yields are generally obtained near the shelter belt due to increased soil moisture.

Field shelter belts are usually spaced 20 to 40 rods apart, and directed north and south. To avoid blocking roads it is generally desirable to place them a distance of 150 feet or more from the road. Along provincial highways shelter belts must be a minimum of 300 feet from the road, unless special permission has been obtained from the Department of Highways. **Field shelter belts should be used with caution on sloping lands.** Water from the accumulation of snow may aggravate the water erosion problem.

Excessive clearing of the land has undoubtedly contributed to the onset of wind erosion in the park belt and forest area. Wind erosion can become serious

in the forested areas and all possible precautions should be observed in preventing erosion. Clearing operations should be undertaken with this fact in mind. (For information on "Tree Planting" see page 84.)

Sandy Soils—Sandy soils are extremely subject to drifting because they do not form resistant clods.

Recommendations for this type of land are:

(a) Seeding down permanently to grass or a grass-legume mixture for hay or pasture.

(b) Cropping every year to wheat, oats, barley, spring or fall rye. Leave the stubble as high as possible to collect snow.

In moister areas such as the Black and Grey Soil Zones, a rotation including grass, legumes or a grass-legume mixture gives satisfactory control of erosion on sandy lands. Seeding down for a few years, followed by breaking and a limited number of grain crops provides a flexible form of rotation on such soils.

Sandy soils are likely to erode whenever the surface is unprotected. Therefore, cultural practices should be planned so that there is the least possible exposure of bare, unprotected soil. Any cover, even weeds, is better than no cover. It is recommended that sandy soils be worked only when moist and packed immediately.

Emergency Methods—Emergency methods are used to deal with two specific conditions of soil drifting:

(a) The commencement of soil drifting on one or more isolated spots in a field that otherwise has not suffered from drifting. This can eventually involve much larger areas if not controlled.

(b) Widespread drifting over whole fields, or larger areas, due to lack of stubble and trash or a cloddy surface.

Preventative measures must be immediate and thorough in order that the spread of drifting soil will be checked. Delay or inadequate measures endanger neighboring farms so that the community as well as the individual may suffer the consequences.

The following emergency measures are recommended:

(a) Plow furrows at intervals of 10 to 30 feet around and across the area.

(b) Deeply ridge the area with an implement such as a duck-foot cultivator or one-way, with half the shovels or discs removed or cultivators equipped with listing shovels.

(c) Spread manure or straw over the areas that are likely to drift preferably before drifting starts. After spreading, the straw or manure should be anchored in the soil by the use of a disc implement.

Portions of a field which are a continual menace should be seeded permanently to grass or a grass-legume mixture.

Where large areas are drifting it may be necessary to adopt strip cultivation to gain control, after which the area can be farmed by the most applicable methods previously described.

On lighter soils where the surface has been removed by wind erosion, further drifting can be checked by discing the entire area when the soil is wet and then seeding immediately. Following this treatment the field should be watched closely and furrows plowed at once should any part of the area begin to drift.

Cover Crops—Can be used for emergency control where trash cover is very poor and a serious wind erosion problem is likely to develop in the early fall. This method should be used with caution since excessive fall growth may cause a serious depletion of moisture for next year's crop. (Consult your Agricultural Representative or your nearest Experimental Farm.)

WATER EROSION AND ITS CONTROL

In recent years there has been a notable increase in damage by water erosion in Saskatchewan. In some areas it has become the most important soil problem. Loss of fertile top soil and exposure of the less productive subsoil is one of the most serious consequences of water erosion.

Almost any soil may be affected and damage will occur whenever water is allowed to run over bare, unprotected land. The faster the water flows, and the greater the amount of flow, the greater the damage will be. Heavy rains or quick thaws may occur in any part of this province so that bare, unprotected fields are always in danger of being damaged by water erosion.

Damage from water erosion occurs in several ways:

Sheet Erosion results in a more or less uniform loss of the surface soil. It is most common on knolls, and the upper slopes. This type of erosion often es-

capes notice but it seriously affects the productivity of the soil.

Rill Erosion also results in the removal of the top soil by forming miniature gullies a few inches deep, which commonly follow implement marks down the slope. On longer slopes rills tend to converge into single channels and eventually form gullies.

Gullies are channels of such width and depth that they interfere with field operations. Gullies are often the first observed sign of water erosion but usually there is considerable damage from sheet and rill erosion before gullies form. Once gullies have formed, the expense and difficulty of controlling erosion is greatly increased. When implements can no longer cross gullies, the farm is cut up into small, irregular shaped fields with consequent added cost of cultivation.

Conditions that affect the amount of water erosion are:

(a) Structure or tilth. Soils with a good granular structure (commonly spoken of as good tilth) readily absorb water so that less remains to run over the surface to cause erosion. Maintaining or improving the organic matter content of the soil will help to ensure good tilth and will improve the water intake rate. Returning all stubble and trash, manuring, green manuring, or a suitable rotation are practices which help in maintaining organic matter.

(b) Surface Cover. A growing crop, or stubble and trash on the soil surface, protect the soil against beating raindrops, and against the force of running water.

(c) The Slope of the Land. Both rate and volume of flow will increase with steepness and length of slope, so the danger of erosion is thereby increased.

(d) Direction of Cultivation. Marks left by implements working up and down the slope increase the likelihood of erosion because such marks provide ready made channels for the water to follow.

(e) Soil Texture. Heavy soils are more likely to erode than lighter soils which absorb water more readily. The maintenance of good structure and a good supply of organic matter is particularly important in heavy soils.

Methods of Control

The successful control of water erosion requires the full co-operation of the entire community within the water shed area. Careless management practices in the upper reaches of the water shed may be the cause of severe erosion in lower lying farm areas. **Individual action regarding water diversion may initiate further erosion on neighboring farms.** (See section on irrigation, page 181.)

Many aspects of water erosion control are similar to the control of wind erosion and some of the methods used may be effective for both conditions. Measures for controlling water erosion depend upon increasing the absorption of snow and rain water by the soil; excess water must be directed down the slopes in such a manner that it does not carry any soil with it. These objectives may be achieved by the following practices:

1. Use tillage practices that keep the stubble and trash anchored at the surface of the soil, and produce a minimum pulverization of the soil. The result is to retard run-off and to leave the land in a condition to absorb water. Excessive cultivation and the use of implements which bury and destroy the trash cover should be avoided.

2. Insofar as possible all cultivation should be directed across the general slope of the land. Field strip cropping, or contour strip cropping, where practical, can be used to advantage in preventing water erosion. Where an erosion problem exists fields should never be wider than 40 rods and most efficient protection is obtained with strips from 10 to 20 rods in width.

3. Grasses, legumes, or grass-legume mixtures, when well established provide practically complete protection against erosion. Such crops will also increase the organic matter of the soil, and its capacity to absorb moisture.

4. Steep slopes should be seeded for hay or pasture especially where such slopes may deliver run-off water on cultivated land.

5. **Gully Control** — Once gullies are formed they rapidly increase in size and reclamation becomes a very difficult and expensive task. The application of the erosion control measures outlined above should prevent, or minimize, the development of gullies. Other additional measures are often necessary to prevent the formation, or aggravation, of gullies as follows:

(a) By diverting the flow of water before it reaches the gully, and by providing properly protected outlets for the water flowing in such channels. Diversion channels must be seeded down and the grass (or grass-legume) should be mowed during the summer to prevent excessive silting. It may also be necessary to remove snow in the spring so that the water can run freely in the protected channel.

Badly placed culverts may also contribute to gully formation where they concentrate water and deliver it into a cultivated field. In some cases it may be possible to relocate the culverts so that the flowing water is delivered to a protected natural runway. In other cases, the water may have to be carried along the road ditch before it is diverted into a protected runway.

(b) **Grass or grass-legume mixture provide the most permanent and stable cover for water channels:** Before seeding the grass, the erosion channel should be filled in and packed to form a wide, saucer-shaped runway. Flat-bottomed runways should be avoided wherever possible. Grasses may be seeded either with or without a nurse crop, and at rates double the normal field recommendations. Early spring seeding is preferable and wherever possible seeding should be done across the gully. Where conditions are not suitable for seeding grasses following the preparation of the gully, a grain crop should be seeded to provide a temporary, quick protection. The grasses can then be seeded into the stubble either in the late fall or early spring. It is most important to obtain a uniform grass cover extending well above the highest expected water level in the channel.

A well prepared channel requires little maintenance but should not be used as a farm roadway. Overgrazing should be avoided, but where necessary the grass should be mown to prevent snow drifts in the channel. If further erosion or silting occurs within the channel, these areas should be repaired immediately.

Streambank Erosion. — Problems should be brought to the attention of your local agricultural representative, preferably in the early stages of development.

SOIL FERTILITY AND FERTILIZER PRACTICES

A sound program of soil management must be aimed at maintaining, or building up, the fertility of the soil in order to ensure a satisfactory supply of all of the sixteen nutrient elements which are required for the proper growth of plants. On the average, about 90 percent of the air dry weight of a crop is composed of **carbon, oxygen** and **hydrogen** which are obtained by the growing plant from air and water. The remaining 10 percent of the dry plant weight is composed of the elements **nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, iron, manganese, boron, copper, zinc, molybdenum** and **chlorine,** all of which must be supplied to the plant root system from the soil.

The quantity and availability of the necessary plant nutrients in the soil is dependent on the nature of the rock and mineral particles, and on the presence of an adequate supply of humus and freshly decaying organic matter. **A hard, tough, poorly granulated soil will not produce satisfactorily even if it is well supplied with nutrients.** The importance of organic matter and humus to soil tilth and fertility has already been discussed (see page 10).

The production and marketing of cereal crops, hay and forage, beef and milk, means a continuing removal of nitrogen, phosphorus, potassium and other necessary mineral elements from the soil. Table I indicates the amount of nutrients which are commonly contained in some of the field crops:

Table I

Crop and Yield		Lbs. Required to Grow Crop			Lbs. Removed in Grain		
		Nitrogen	Phosphate	Potash	Nitrogen	Phosphate	Potash
Wheat	— 30 bus.	52	21	29	36	15	9
Oats	— 50 bus.	50	20	52	35	14	9
Barley	— 40 bus.	47	21	38	35	16	10
Flax	— 15 bus.	51	16	27	31	13	8
Alfalfa	— 3 tons	143	33	135	—	—	—

Fifty to seventy-five years of cropping has already removed as much as 20 to 25 per cent of the original supply of nitrogen and phosphorus from Saskatchewan soils. The incidence of wind and water erosion has greatly accelerated this loss in many instances. Best crop yields can only be obtained where fertilizers are used along with other proven production practices.

Phosphate and **nitrogen** are most likely to be deficient although **sulphur** is also commonly deficient on the grey wooded soils for proper growth of legumes. **Grain crops show phosphate deficiency in the following ways:**

(1) Slow growth and poor stooling.
(2) Pale greyish-green color (may be purple on older parts of the plant).

(3) Light crop with short heads.
(4) Slow maturity.

A deficiency of nitrogen for cereals is indicated by:

(1) Pale, yellowish-green color over the whole leaf.
(2) Poor, stunted growth.
(3) Early maturity with poor grain yield.

A deficiency of sulphur in legumes is indicated by a very pale green color and poor, stunted growth.

The above symptoms are most significant when they appear in crops during a favourable growing season. Nitrogen deficiencies are most common during a cool wet season but may be observable on stubble crops during any year, particularly on the Black, Greyish Black and Grey Wooded soils.

Phosphate for Fallow Crops

On the average, an acre of land will contain about 2500 pounds of phosphate in the top six inches. Much of this total amount is present in forms only slowly available, or completely unavailable, to the plant. Although some phosphate is always present in the organic matter returned to the soil, **adequate supplies can only be obtained by the growing crop where phosphate fertilizers are used.** Fifty good crops will remove some 750 pounds of phosphate from each acre of land.

Phosphate fertilizers (particularly ammonium phosphate, 11-48-0) give very favourable results with summerfallow crops on all of the Dark Brown, Black, Greyish-Black and Grey soils and on the Brown clays and clay loams. Table II shows the average yield increases which have been obtained where phosphate fertilizer (11-48-0) has been applied to **wheat on fallow** in field tests throughout the province since 1939.

Table II.—Average Yield Increases of Wheat on Summerfallow

Soil Zone	No. of Trials	Av. Yield increase of wheat from 40 lb. /ac. of 11-48-0
Brown (Clays and Clay Loams)	55	5.1
Dark Brown	104	5.7
Black	118	5.1
Thick Black and Greyish Black	90	7.1
Grey	30	7.0

The response obtained from phosphate may vary greatly from year to year on the same land depending on seasonal weather conditions. **It is desirable to conduct tests over a period of years before deciding to discontinue the use of phosphate for fallow crops on any particular farm. These fertilizers, if properly used, will rarely if ever cause burning of the crop in a dry season.**

Where phosphate fertilizer is used a number of other effects are commonly observable in addition to an increase of grain yields:

(1) More rapid root development.
(2) Better stooling and more vigorous growth.
(3) Better ability of the crop to compete with weeds.
(4) Reduction in root-rots, especially Browning root-rot.
(5) Earlier maturity and stronger straw.
(6) More uniform ripening and generally better grades of grain.
(7) Reduction in erosion because a heavier crop returns more organic matter to the soil.

In addition, the use of fertilizer assists in conserving the fertility of the soil through maintaining the supply of elements like phosphorus which would otherwise be slowly depleted by cropping. **The soil, or the crop, will never be harmed if fertilizers are used in a manner recommended by responsible agencies or individuals.**

Nitrogen and Phosphate for Stubble Crops

Nitrogen is generally not deficient in fallowed lands in Saskatchewan. **Available nitrogen accumulates during the fallow year under good management.** However, on soils which have suffered severe erosion, and on the Grey Wooded soils, the supplies of available nitrogen may also be quite low on fallow land. These soils are generally very low in organic matter and, therefore, available nitrogen. The use of a legume in rotation, or of farm manure, is a valuable means of improving nitrogen supply, tilth and humus content.

While phosphate is the major nutrient deficiency on summerfallowed lands, cereal crops on stubble land require fertilizer nitrogen as well as some phosphate. This is particularly true for the Black, Greyish-Black and Grey soils. Profitable responses to nitrogen-phosphate fertilizers may also be obtained on the Dark Brown Soils, and on the Brown clays, if moisture conditions are

very good both at planting time and during the growing season.

The supplies of available nitrogen are dependent on the activity of microbes within the surface soil. Where the land has been cropped the previous year, the supplies of available nitrogen will still be low at seeding time. Where large amounts of plant materials are worked into the soil a temporary shortage of nitrogen may result because the organisms which promote decay are feeding on the supplies of available nitrate. A similar situation may prevail following the breaking of old stands of tame grasses. Deficiencies of nitrogen can also occur where the activity of the nitrifying organisms is slowed down by unfavourable conditions such as cool temperatures and excessive moisture.

Fertilizers with a high proportion of nitrogen to phosphate, such as 16-20-0, or 27-14-0, are very valuable in overcoming deficiencies of nitrogen in stubble crops. Table III indicates the average yield increases of wheat and barley on stubble where both nitrogen and phosphate are supplied at seeding time. Tests were mainly conducted within the Black, Greyish Black and Grey soil zones, 1949-1958.

Table III—Response to Fertilizers by Stubble Crops

Fertilizer	Lbs./ac. Applied	Crop	Yield increase bus./ac.	No. of Tests
11-48-0	40	wheat	4.2	32
16-20-0	50	wheat	3.2	32
16-20-0	100	wheat	7.2	32
27-14-0	75	barley	9.0	30
16-20-0	100	barley	10.6	17

Where nitrogen effects are to be tested with cereal crops on stubble lands, the nitrogen-phosphate fertilizers should be placed with the seed at rates giving at least 15 to 25 pounds of nitrogen per acre. **It is undesirable to place more than 25 pounds per acre of nitrogen with the seed.** If it is necessary to use nitrogen applications in excess of 25 pounds per acre, a granular, pure nitrogen fertilizer such as 21-0-0 (sulphate of ammonia) or 33.5-0-0 (ammonium nitrate) can be applied on the soil surface either in late fall or early spring. Anhydrous ammonia (82-0-0) can also be used. This form of nitrogen is released into moist soil as a gas using a special applicator. In general, its benefits in the form of increased yields are no different than those obtained with 21-0-0 or 33.5-0-0 when applied at an equivalent rate of nitrogen. **Losses of ammonia gas may be considerable where it is released into dry soil.**

Where surface applications of pure nitrogen fertilizers are used, phosphate (11-48-0) must also be placed with the seed at seeding time or a serious delay in crop maturity may result.

Where a deficiency of available nitrogen is a continuing problem properly inoculated legumes can also add considerable quantities of nitrogen to the soil. The nodule-organisms are able to obtain nitrogen from the plentiful supply in the atmosphere.

Nitrogen for Grasses

The best yields of hay and pasture can be obtained from grass-legume mixtures where the inoculated legume is able to supplement the supplies of nitrogen for the grasses. However, nitrogen fertilizer (without any phosphate or potash) does markedly stimulate the growth of grasses. The response is dependent on moisture conditions and its use is most generally recommended within the Black, Greyish-Black and Grey soil zones for older stands of grass-legume where the percentage of legume is small, or on straight grass fields for hay and pasture. Unproductive stands of grasses can also be handled by breaking and reseeding to a grass-legume mixture.

The use of nitrogen fertilizer where grasses are being grown for seed production can be very profitable. Profits from this practice are, however, very dependent on the market value of the grass seed produced.

Selection of Suitable Fertilizers

The sale of all fertilizer materials in Canada is regulated by the Plant Products Division of the Canada Department of Agriculture, under the authority of the Fertilizer Act. The analysis of the fertilizer with regard to its content of **nitrogen, phosphate** and **potash** must always be clearly indicated on the container and is guaranteed by the company manufacturing it. **A short method of indicating the percentage of each of these three plant nutrients is always used in the same manner. For example, a 11-48-0 fertilizer contains 11 per cent nitrogen, 48 per cent phosphate and no potash.** The order of expressing such

analyses is always nitrogen-phosphate-potash, and where an element, or elements, is not present the formula will indicate this as follows: 21-0-0 is a nitrogen fertilizer (21 per cent) which contains no phosphate or potash.

In addition to the three nutrients named above, other important nutrient elements may be present although not shown in the standard analyses. **Sulphur is of particular importance in this regard as it is generally required for best production of legumes on grey wooded soils.** Therefore, fertilizers used for legumes (see following fertilizer recommendations) on grey wooded soils should contain a sufficient amount of this element.

The number of different types and formulations of fertilizers which are on the market in Saskatchewan has increased markedly in recent years and is likely to continue to do so in the future. **Fertilizers should be purchased by considering the guaranteed analysis which tells the quantity and kind of nutrient present. The cost of a fertilizer should, in general, bear a relationship to its content of plant nutrients.** For example, if phosphate is being purchased for use with cereal crops on summerfallow land, a fertilizer carrying 20 per cent of phosphate should only be half as valuable as one which contains 40 per cent of this nutrient. On the other hand, if nitrogen is being purchased for use on hay or pasture lands, 21-0-0 should cost only about two-thirds as much as 33.5-0-0. **The cost of the fertilizer should be calculated in terms of the content, in pounds, of the plant foods needed for your crop. Phosphate is the major requirement for fallow crops, nitrogen and phosphate for stubble crops and only nitrogen for grasses.**

If a 27-14-0 fertilizer were purchased for fertilization of a summerfallow crop, money would be wasted in purchasing extra nitrogen which is not needed by the plants and the extra nitrogen might also cause a serious delay in maturity.

Recommendations on Fertilizer Practices are approved and published annually by the Saskatchewan Advisory Fertilizer Council under the authority of the Minister of Agriculture for Saskatchewan. For the most recent recommendations, or for any changes in recommendations, consult your Agricultural Representative, Experimental Farm, The Saskatchewan Department of Agriculture or the University of Saskatchewan. **New fertilizer materials or formulations should be approached with caution until they have been proven for Saskatchewan conditions, either by field tests or by comparison with another proven formulation.**

The recommendations as set forth in Table IV are those approved by the Advisory Council for 1959.

Special Fertilizer Problems

(1) **Sulphur for Legumes on Grey Soils.** —Sulphur is needed for best production of legumes on most Grey soils. When seeding a legume, **16-20-0 fertilizer** which also contains 14 per cent sulphur, should be used with the nurse crop at 50 to 60 pounds per acre.

On established stands of legumes, use an annual application, either in late fall or early spring, of one of the following sulphur bearing fertilizers:

Gypsum—at 40 to 100 pounds per acre, or
21-0-0—at 30 to 80 pounds per acre, or
16-20-0—at 50 to 150 pounds per acre.

The lower rates of application are recommended for seed production and the higher rates for hay crops.

(2) **Where fertilizer is recommended for stubble crops** it may be profitable on certain soils, or under certain conditions, to experiment with high rates of application of nitrogen (in excess of 25 pounds per acre). Such applications must be used as a surface broadcast, either in the fall or before the first tillage in the spring. **Germination damage can result if too much nitrogen is placed in contact with the seed.** For these surface applications use one of the following fertilizers:

33.5-0-0—at 90 to 120 pounds per acre, or
21-0-0—at 150 to 200 pounds per acre, or
Anhydrous (Agricultural) Ammonia at 40 to 50 pounds per acre.

Nitrogen fertilizers do not contain any phosphate and, if they are used, an additional application of 30 to 40 pounds per acre of 11-48-0 should be applied with the seed at seeding time.

Where nitrogen is broadcast in the spring, its use by the crop may be very ineffective if there is a prolonged dry period following seeding.

(3) **Where grains are to be sown on grass breaking** a nitrogen-phosphate fertilizer should be used at the rates recommended for stubble crops (see Table IV).

RECOMMENDATIONS FOR GRAINS AND GRASSES

SOIL ZONES	WHEAT, OATS, BARLEY		CULTIVATED GRASSES ON DRYLAND	
	Summerfallow Crops	Stubble Crops	For Seed Production	For Hay and Pasture*
Brown Soils	Sceptre heavy clay: 11-48-0 at 40 pounds per acre.	**For trial:** If depth of moist soil is over 24 inches and surface moisture is good, 16-20-0 at 90 to 120 pounds per acre **or** 27-14-0 **or** 23-23-0 **or** 24-20-0 } At 60 to 80 pounds per acre.	33.5-0-0 (ammonium nitrate) at 100 to 200 pounds per acre **or** on soils with known phosphate deficiency 100 to 200 pounds of 16-20-0. Applied in September.	Fertilizers not recommended. (See Foot Note*.)
Dark Brown Soils	(See Foot Note 1) Clay loams to heavy clays: 11-48-0 at 40 to 60 pounds per acre. Sandy loams to loams: 11-48-0 at 30 to 40 pounds per acre.	**For trial:** If depth of moist soil is over 24 inches and surface moisture is good, 16-20-0 at 90 to 120 pounds per acre **or** 27-14-0 **or** 23-23-0 **or** 24-20-0 } At 60 to 80 pounds per acre.	33.5-0-0 (ammonium nitrate) at 100 to 200 pounds per acre **or** 21-0-0 (ammonium sulphate) at 150 to 300 pounds per acre. Applied in September.	**For trial:** 100 to 200 pounds of 33.5-0-0 per acre **or** 150 to 300 pounds of 21-0-0 per acre. Applied in fall or early spring.
Black Soils	(See Foot Note 1) Clay loams to clays: 11-48-0 at 40 to 60 pounds per acre. Sandy loams to loams: 11-48-0 at 30 to 50 pounds per acre.	27-14-0 **or** 23-23-0 **or** 24-20-0 } At 60 to 80 pounds per acre. **or** 16-20-0 at 90 to 120 pounds per acre.	33.5-0-0 (ammonium nitrate) at 150 to 300 pounds per acre **or** 21-0-0 (ammonium sulphate) at 250 to 500 pounds per acre. Applied in September.	100 to 200 pounds of 33.5-0-0 per acre **or** 150 to 300 pounds of 21-0-0 per acre. Applied in fall or early spring.
Thick Black and Greyish-Black Soils	11-48-0 at 40 to 60 pounds per acre.	27-14-0 **or** 23-23-0 **or** 24-20-0 } At 60 to 80 pounds per acre. **or** 16-20-0 at 90 to 120 pounds per acre. (See Foot Note 2)	33.5-0-0 (ammonium nitrate) at 150 to 300 pounds per acre **or** 21-0-0 (ammonium sulphate) at 250 to 500 pounds per acre. Applied in September.	100 to 200 pounds of 33.5-0-0 per acre **or** 150 to 300 pounds of 21-0-0 per acre. Applied in fall or early spring.
Grey (Wooded) Soils	11-48-0 at 40 to 60 pounds per acre.	27-14-0 **or** 23-23-0 **or** 24-20-0 } At 60 to 80 pounds per acre. **or** 16-20-0 at 90 to 120 pounds per acre. (See Foot Note 2)	33.5-0-0 (ammonium nitrate) at 150 to 300 pounds per acre **or** 21-0-0 (ammonium sulphate) at 250 to 500 pounds per acre. Applied in September.	100 to 200 pounds of 33.5-0-0 per acre **or** 150 to 300 pounds of 21-0-0 per acre. Applied in fall or early spring.

FOOT NOTES

(1) In all zones for the range in rates given, use the lighter rates for the light soils in the class and the heavier rates for the heavy soils in the class.

(2) For clay and heavy clay soils use 27-14-0 at the highest rate recommended on stubble crops on the grey, greyish-black and thick black soils.

*(*a*) Best production of hay and pasture in all zones is obtained from legume-grass mixtures. For fertilizer recommendations on legume-grass mixtures see SPECIAL RECOMMENDATIONS.

(*b*) Response to nitrogen on grass depends very strongly on moisture conditions. Profit from the use of nitrogen on grass for seed production varies with the price of grass seed.

(4) **Flax** on summerfallow land has shown a variable response to phosphate fertilizer. An application of 30 pounds per acre of 11-48-0 may be used. Flax sown on stubble land may respond profitably to a broadcast application of 100 pounds per acre of 33.5-0-0.

(5) **Rape on summerfallow**—use 11-48-0 at 40 pounds per acre.

(6) **Fall rye**—use 11-48-0 at 40 pounds per acre except in the Brown soil zone.

(7) **Peas**—use 11-48-0 at 40 pounds per acre.

(8) **Saline soils**—where cereal crops can be grown, use 11-48-0 at the recommended rate (Table IV). Grasses may respond to applications of nitrogen in some cases.

Leave a Check Strip

In all cases where fertilizer is used it is advisable to leave an unfertilized check strip in the field. This enables the observation of the effects of the fertilizer on crop growth throughout the season, and an estimate of fertilizer benefits can be obtained. Wherever possible, it is very valuable to harvest the check strip separately and to compare its yield with that of an adjacent equal area of fertilized crop. **A neighbor's unfertilized field is not a suitable check.**

If fertilizer proves to be beneficial and profitable on a farm, its use should be continued. The soil will never be harmed by the use of fertilizers which are properly registered and which comply with the requirements of the Fertilizer Act. **"Apparent burning" of the crop should not be confused with earlier maturity due to the stimulation from phosphate fertilizer.**

Application of Fertilizers

For best results, fertilizers should normally be applied with a **proper attachment** for the seeding equipment. This places the fertilizer in close contact with the seed and the young seedlings are able to make the best use of the applied fertilizer. This is particularly important where **phosphate** is needed; although phosphate is readily dissolved, it will not move very far in the soil. **Phosphate applied on the soil surface, or mixed into the surface, will not produce as efficient results as when placed in contact with the seed.**

Most nitrogen compounds are readily dissolved and can move freely with the soil moisture, thus they can be applied on the surface if desired. **However, where nitrogen is being used in moderate amounts (less than 25 pounds of N per acre) it will prove to be most efficient if placed in close contact with the seed and with the phosphate as part of a nitrogen-phosphate fertilizer.** A surface broadcast application of nitrogen for cereal crops should only be used where the rates of use are high enough that they may cause germination damage if placed in contact with the seed. **Nitrogen required for grasses on hay or pasture fields can be broadcast or drilled into the sod where the fertilizer attachment has a suitable capacity.**

Proper fertilizer attachments are available for all types of seeding equipment, either through local implement dealers or fertilizer agents. They are easily attached and do not interfere in any way with the normal operation of seeding equipment. **Fertilizer should not be applied by mixing with the grain in the seed box. This practice will cause injury to the seeding mechanism and will also result in a very uneven seeding of both the grain and the fertilizer.**

Where fertilizers must be applied as a broadcast application they can best be applied with a lime spreader. These implements are adaptable for high rates of application and are available through several implement companies. If necessary, lower rates of applications can be made with the ordinary fertilizer attachment on the seeding equipment. Newer designs of fertilizer attachments can be adjusted to deliver much higher rates of application. A "Cyclone Seeder" is also convenient for broadcasting fertilizer on a small acreage.

Fertilizers for Garden and Lawns

Both phosphate and nitrogen can be used to advantage for the production of **Horticultural Crops** and for **Lawn Grasses.** Manure and other organic materials are also important to good practices and best production. Circulars and Bulletins on these practices are available from the Saskatchewan Department of Agriculture and the University of Saskatchewan. **Your local Agricultural Representative should be able to make these materials available.**

Most garden seeds are quite sensitive to fertilizer and it should never be placed in close contact with them. (See section on Horticulture, page 72.)

SPECIAL SOIL PROBLEMS

Saline and Alkali Soils

Saline soils are of widespread occurrence in Saskatchewan and are a major problem on some farms.

Salinity is caused by the presence of excessive amounts of some common soluble salts. The salts responsible in

Saskatchewan are mainly sodium sulphate (Glauber's salt), magnesium sulphate (Epsom salts) and calcium sulphate (Gypsum). Occasionally, sodium chloride (common table salt) is also present.

Where the concentration of salts is very high, bare patches appear which show a white crust of salts in dry weather. This is the so-called "white alkali". Where less salts are present the soil has greyish color when dry and the subsoil will often have concentrations of salts in specks at a depth of six to ten inches or deeper. While a good covering of native vegetation may be present, the plants are commonly of low food value but have high tolerance to salts. The appearance of the soil and of the vegetation is, therefore, a useful indication of the presence of salinity. Since the salts are soluble, they commonly accumulate in low, flat areas where they are carried by water and left as the water evaporates.

In order to determine the amount and kind of salts present it is necessary to have the soil analysed. (See page 24.)

The production of saline areas may be improved (a) by the use of manure or green manures; (b) by growing salt tolerant crops, and (c) by the improvement of surface and subsoil drainage. There is no chemical treatment which will remove salts or neutralize their effect However, the use of phosphatic fertilizers may promote better growth of grains and grasses on some saline soils (See special fertilizer recommendations.)

Below are some of the common field crops grouped in order of their tolerance to salinity:

1. **Seed Crops**
   - (a) Rape, barley, rye and oats, fairly tolerant.
   - (b) Wheat and flax—slightly tolerant.
2. **Forage Crops**
   - (a) Tall wheat grass—good tolerance and is adaptable to wet soils.
   - (b) Slender wheat grass (Western Rye Grass)—quite tolerant.
   - (c) Sweet clover—good tolerance.
   - (d) Alfalfa—good tolerance once established.
   - (e) Brome, crested wheat grass and reed canary grass—moderate tolerance.
   - (f) Alsike and red clover—slight tolerance.
   - (g) Red top and timothy—not tolerant.

See section on Forage Crops for suitable mixtures for saline areas. (See page 64.)

3. **Garden Plants**—Beets and mangels have a high tolerance to salinity, potatoes moderate tolerance and corn slight tolerance.

Small fruits, tree fruits and many of the decorative plants have low tolerance. Saline areas should be carefully avoided in selecting a garden site.

True alkali soils are not as widespread as are saline soils but in many ways are more difficult to handle, especially in irrigation projects.

Alkalinity is the opposite to acidity, and in alkali soils small amounts of caustic substances are present mainly originating from the presence of an excess of the element sodium in the soil.

If the soil is very alkaline, a considerable amount of sodium carbonate (washing soda) is usually present. Under such conditions some humus may dissolve and form a black surface crust, or give standing water a dark brown color. This is the origin of the term "black alkali" which has been commonly used to describe these soils.

Alkali soils in contrast to saline soils have very poor structure. Moisture movement through such soils may be reduced to almost zero. The alkali condition is more detrimental to plant growth than is salinity. An intermediate condition exists where both the saline and alkali conditions occur in the same soil. These are called saline-alkali soils.

On irrigation projects, both salinity and alkalinity are serious problems. The saline condition is more easily dealt with since water movement through saline soils is relatively rapid. If satisfactory drainage is established salts can be removed by leaching with successsive applications of irrigation water.

Alkali soils are much more difficult to treat so that substantial improvement can be effected. Good drainage and leaching with applications of irrigation water may result in gradual improvement providing a reasonable amount of water will move through the soil. The use of chemical amendments such as gypsum or sulphur may be necessary to promote more rapid and effective reclamation of alkali soils.

Lands being considered for irrigation should be carefully examined to avoid highly saline or alkali areas if possible.

(For further information on irrigated lands, see page 181.)

Light Colored Eroded Soils

Light colored knolls in cultivated fields result from the removal of part or all of the top soil, and the exposure of the light colored limy sub-soil. Such soils are droughty and low in productivity, and there is a lack of uniformity in maturity of crops as well as in stand.

In improving these soils, it is most important to build up their organic matter content. This may be done by manuring, or by turning under green manure crops. All crop residues should be worked into the soil. The productivity of the soil may be improved by the use of a nitrogen-phosphate fertilizer. Wind and water erosion must be prevented, and all tillage operations and cropping practices should have this end in view.

Sometimes these eroded areas cannot be improved while the field is being cultivated due to the continuation of erosion. In such cases, it is advisable to seed the field either temporarily, or permanently to grass or a grass-legume mixture.

"Bluff Podzols"

In the park belt the low spots frequently have greyish white soils which have poor structure and usually produce light unthrifty crops. Their productivity can be much improved by adding organic matter in the form of farm manure, by turning down legume crops such as sweet clover and by using fertilizer for cereals. These soils are not saline and can be brought to a reasonably satisfactory state by improving their organic matter content.

Peat

The burning of peat is a practice which generally should be avoided since it leads to a great loss of nitrogen and organic matter, and it may result in the exposure of an infertile mineral soil. In some cases it is possible to remove the loose surface of the peat and burn it without destroying the underlying better decomposed layers but such burning often leaves a very rough land surface.

Drainage is essential to successful cultivation of peaty areas. In shallow peats, where plowing may mix some mineral soil with the peat, coarse grains may be grown successfully on the newly broken land although suitable forage crops may be better in hastening reclamation of the peat and in reducing the frost hazard.

Deeper peats are best pastured for a few years before breaking. The grazing animals pack and manure the peat and hasten its decomposition into a more desirable state. After breaking and discing the use of a float may be necessary to smooth the surface. Heavy packing in preparing the seed bed is necessary to ensure even depth of seeding. With the deeper peats it is usually advisable to grow forage crops for a few years before attempting to grow early maturing grains. Peat soils generally respond to fertilizers such as 11-48-0 or 16-20-0 ammonium phosphates. Where peat is burned the land should be manured, or clover crops turned in to restore organic matter.

THE "BLOWOUT" OR "BURNOUT" SOILS*

"Burnout" soils occur in several large areas on the prairies and in some small areas extend into the margin of the forest. They are characterized by an uneven pitted surface and an extremely heavy impermeable sub-surface layer. The pits, or depressions, are the result of erosion some centuries ago. The depressions, roughly circular in outline, are from a few feet to many feet in diameter and from six to twelve inches deep. Where the depressions occur, the top soil has usually been completely removed and the hard subsoil exposed. It is this fact which is responsible for the difficulty found in successfully cultivating such soils. All organic matter, such as straw and stubble, should be worked into such soils and summerfallowing must be carefully done to conserve moisture. It is advisable to fallow every other year for moisture conservation.

The summerfallow should be worked early in May to a depth of 4 to 5 inches. For the first operation a one-way is a suitable implement, unless stubble is light and the soil dry, in which case a cultivator or blade implement should be used. Through the remainder of the season cultivation may be done with a blade implement, duck-foot cultivator or rod-weeder. A depth of 3 to 4 inches is suitable for these later operations. Early working of the summerfallow is most important so that these soils may be kept moist and friable throughout the season.

"Burnout" soils tend to improve under cultivation. There are two reasons for this. First, there may be an increase in organic matter and improvement in tilth. Secondly, the surface soil is spread over the depressions by cultivation and

*Described fully under Echo and Trossachs Associations, Soil Survey Report No. 12, University of Saskatchewan, Saskatoon.

so the subsoil layer is at least partly covered. Power equipment and careful management are important factors in farming the "burnout" soils, and seem to be almost essential to success.

SOIL TESTS

Soil tests are of little value unless some specific problem exists in the area. For example, general recommendations as to the use of fertilizers, type of crop and cultural practices for different, areas, can generally be made on the basis of information already available. The following are examples where useful knowledge may be obtained from a soil test:

1. The presence of "alkali" is suspected.
2. An unproductive area exists in a field or farm that is otherwise productive.
3. Some unexplainable peculiarities of plant growth are observed.
4. The soil is thought to be acid (sour).
5. Where general evaluation of the soil for cropping is desired or where some doubt exists as to the productivity of unbroken areas.

It should be pointed out that the problem may be one which cannot be diagnosed by laboratory tests as in cases where insects or crop diseases are the cause of the trouble.

Great care is required in the selection of a soil sample if it is to represent the problem area. Distinctly different soils should be sampled separately. Both **surface** and **subsoil** samples must be forwarded from each area sampled. A surface sample selected from the adjacent productive area should also be submitted.

The Surface Sample.—The surface soil is sampled to the depth of cultivation. Take six to ten samples from within the area, mix these thoroughly in a clean pail or other container and forward about one pound (one quart) of the soil from this mixture.

The Subsoil Sample.—Select two or more representative points within the area and take sub-surface samples at a depth of between twelve to eighteen inches. These are mixed as above and about one pound of this soil forwarded for analysis.

Labelling.—Samples must be clearly labelled as to **location, depth** and **sender's name.** It is preferable that samples be labelled on the outside of the container but a slip of paper placed inside with the soil is satisfactory. If more than one set of samples are forwarded, they must be numbered so that each set (surface and subsoil) may be referred to separately.

Containers.—Samples must be forwarded in clean, durable containers. Never use containers which have held table salt, Epsom salts, baking soda, washing soda, or any other chemical.

Answer all of the following questions as fully as possible and return them with your sample. In many instances, an adequate recommendation cannot be made without this information.

Information to be Submitted with Samples

1. Name ..... Address .....
2. Location: Sec..... Twp..... Range..... M..... Size of problem area:..... acres.
3. Specific reason for requesting analysis: .....
4. Have you noted any pecularities in the growth of crops? .....
5. What crops have been grown?.....
6. What weeds are most troublesome on the land? .....
7. How long has the land been under cultivation? .....
8. Describe the natural vegetation if the land is uncultivated? .....
9. Describe the topography (level, rolling or hilly) .....
10. Is the area liable to flooding? .....
11. How much damage has there been from wind or water erosion? .....
12. Have you used fertilizer and, if so, what kind, at what rate and for how many years? .....
13. When sampled, was the soil too wet to cultivate? .....; too dry to cultivate? .....; or satisfactory for cultivation? .....
14. Number of samples submitted .....
15. Number of acres represented by each sample .....
16. Any additional information which may be useful in diagnosing your problem? .....

NOTE: Samples to be tested should be forwarded to the Department of Soil Science, University of Saskatchewan, Saskatoon.

Where additional information is desired with regard to soils or soil management the following publications should be consulted:

1. Saskatchewan Soil Survey Report No. 12, 1947, University of Saskatchewan.

2. Saskatchewan Soil Survey Report No. 13, 1950, University of Saskatchewan.

3. Gardener's Guide for Manuring and Fertilizing, 1959, University of Saskatchewan.

4. Publications from Plant Industry Branch, Department of Agriculture, Regina:
   (a) Summerfallow Early
   (b) Grassed Waterways for Gully Control
   (c) Stubble Saves the Soil
   (d) The Seeding and Care of Lawns in Saskatchewan

5. Recent Progress Reports, or Annual Summaries of Data, from your nearest Experimental Farm (Indian Head, Melfort, Regina, Swift Current or Scott).

* * *

PAINTING ON THE FARM

Developing a painting program for farm buildings and equipment is worthwhile on every farm. Buildings should be kept painted in order to improve their appearance and prolong their life. A set of well-painted farm buildings adds beauty to a farmstead and results in pride and greater satisfaction to the owner. Paint keeps metal from rusting and aids in preventing lumber from checking, warping, and decaying.

Many people consider painting a job requiring the knowledge and skill of an experienced painter. When skilled painters are employed, the labor cost often amounts to two-thirds or more of the total cost of the paint job. Although in some cases it is desirable to employ skilled painters, much exterior painting can be done by unskilled or local farm labor if they will acquire certain fundamental knowledge of the proper selection and application of paint. Where the total cash outlay is essentially for materials alone, more farm buildings may be painted.

A SUCCESSFUL PAINT JOB

A good paint job provides a hard, tough, and yet elastic paint film of the proper thickness to give maximum protection and present a good appearance for as long as possible.

Many factors affect the durability of a paint film or the quality of a paint job, but the following four requirements are the most important:

1. **Buy good paint.** Use a high quality ready-mixed paint made for a specific purpose or use a home-mixed paint made from properly combined high quality materials.

2. **Prepare the building and surface, if necessary, to prevent early paint failure.** Repair and maintain the building to keep moisture from getting to the back side of the paint film. Clean the surface of dirt and other foreign material. A cracked or seriously flaked paint film should always be removed before repainting.

3. **Apply paint properly.** Paint only when weather conditions are favorable. Mix and apply each coat of paint in such a way as to get a tough elastic film of the proper thickness. Use two or three coats of paint on new wood and one or two coats on repaint jobs.

4. **Plan a paint program.** No paint will last forever, so you must expect to paint again. Plan to paint at regular intervals in the future, the number of years between the paint jobs depending largely upon the type and quality of paint you choose. For best results the same type of paint must be used on repaint jobs as was used for the first job.

Cropping Systems and Cultural Practices

The best cropping system on any farm is largely determined by soil and climate. The farm program must also take account of the farmer's own inclination. A livestock enterprise will not thrive for a farmer who does not like livestock.

Feed supply, weed, disease, and insect control, as well as market conditions must be considered in developing the best farm program.

On grain farms, livestock enterprises should only be such as to use the forage from uncultivated land and by-products of grain production. On a livestock farm, production of feed is the first consideration.

The best approach to planning the cropping system is a check on returns from different practices by well kept farm records. On soils where forage crops and livestock give the best return, cash grain production should be restricted to a secondary place. On the other hand, livestock may not be suitable for grain farms. In some cases straw that is needed for soil protection is fed to livestock.

Lack of moisture is the main limiting factor in planning cropping systems. Moisture conservation and moisture use is a major problem on most farms in Saskatchewan.

TABLE I
MOISTURE USE AND CONSERVATION

Soil Texture	Normal Storage Capacity of Available Moisture to a Depth of 4 Feet
Sandy Loam	4.2 inches
Loam and Silt Loam	6.2 inches
Clay Loam and Silty Clay Loam	7.2 inches
Clay and Silty Clay	7.8 inches
Heavy Clay	8.8 inches

The average annual precipitation in a large part of Saskatchewan is only 15 inches of which 7 to 8 inches fall in the growing season. Moisture use studies at Swift Current indicate that 10 to 12 inches of water are needed to grow a 15-bushel crop of wheat. It follows that a reserve of 3 inches or more in the soil is needed to grow 15 bushels of wheat with average seasonal rainfall.

Soils differ in the amount of water they can store. Heavy soils may store enough moisture to grow some crop with very little rainfall. Sandy soils can store little more than the harvest to seeding precipitation. The only way to check moisture conditions is to use a soil auger or spade in the spring. Moist soil forms a ball and depth of moist soil can be determined readily. Table I shows the amount of water stored in 4 feet of different soils.

The best use of moisture depends on three things. First, moisture must get into the soil before it can be used. Second, weed growth must be controlled to prevent loss of stored moisture. Third, rotations and cropping plans must be designed to make maximum use of moisture.

Summerfallow is the most important practice used to store moisture in the soil. About 50 per cent of the moisture stored in summerfallow is already in the soil in the spring of the summerfallow year. If weeds are allowed to grow too long in the spring, much of this moisture is removed by the weeds. Besides, the surface becomes dry and is powdered by tillage. Early tillage, at the right moisture content, keeps the surface in condition to take in water. Table II shows how yields are improved by starting summerfallow early.

TABLE II
EFFECT OF DATE OF STARTING SUMMERFALLOW OPERATIONS ON YIELD OF WHEAT
Swift Current 1948-1956

Date of Starting Cultivation	Yield of Wheat Bushels Per Acre
May 15	24.4
June 1	22.7
June 15	21.9
June 30	20.6

At the Scott Experimental Farm, over a 37-year period, summerfallow started on May 15 yielded 2.3 bushels more wheat per acre than that started June 15 and 5.5 bushels more than that started July 15.

Later work on summerfallow should keep weed growth down and trash cover on the surface. A good trash cover prevents run-off and may reduce evaporation.

Summerfallow is an essential part of the program on the medium to heavy brown and dark brown soils. (See Table I.) Unless needed for weed control, summerfallow does not make best use of water on sandy soils. Summerfallow on sandy land is dangerous because of soil drifting.

On the black and grey soils, the need for summerfallow is not so great. Evaporation is much lower on these soils and more of the total moisture is available for crop use. If fertility needs are provided through the use of grain-forage rotations and commercial fertilizers, returns from crops on stubble land compare favourably with those from summerfallow.

As organic matter supply in the soil goes down, run-off increases. Return of all crop residues, barnyard manure and grain-forage rotations will help to maintain organic matter and increase water intake. Disc implements and harrows should be used with care. Powdered soil increases run-off.

Recent experimental work shows that barnyard manure and commercial fertilizer reduce the amount of water needed to grow a bushel of grain. Where moisture supply is good and a well seeded crop yields poorly, improvement in fertility and soil condition is needed.

The regular and timely use of chemicals for weed control is a major factor in moisture use. Spraying for weed control at the right time leaves more moisture for the crop. (See Weed Control page 85.) Prevention of weed seed production leaves fewer weeds to kill on summerfallow. Fall weed growth is less and fall storage of moisture may therefore be increased.

CROPPING SYSTEMS

THE BROWN AND DARK BROWN SOILS

Cropping systems for the brown and dark brown soils must be planned to make the best use of moisture.

The two-year rotation of grain and summerfallow is satisfactory on the better wheat soils. In the more moist portions of the dark brown soil zone, a three-year rotation of grain-grain-summerfallow is suitable. In years when stubble land has over 24 inches of moist soil at seeding time, land reasonably free of weeds is likely to give fair yields.

Experimental results in southwestern Saskatchewan show that returns from two-year and three-year rotations are similar. Summerfallow provides some crop insurance. The heavier growth of summerfallow crops leaves a better trash cover for the following year. The main disadvantage to summerfallow is the danger of soil erosion. The cultivator, rod weeder, or blade helps to keep a good trash cover on summerfallow fields. (See Soils Section, page 12 [wind erosion].)

Sandy soils and light loam soils in the brown and dark brown soil zones are likely to drift under cultivation. The best treatment for the sandy loam areas is to seed to grass-legume mixtures. For grain farming on light soils, continuous cropping gives the best returns if weeds can be controlled. Results at Conquest show production from continuous cropping is 50 per cent higher than from a two-year rotation. It is slightly higher than that from a three-year rotation.

Wheat and barley are the best grains for the brown soils. On the dark brown soils, oats often produce heavier yields than wheat and barley. On the heavy soils in both zones wheat usually gives higher returns than coarse grains.

Fall rye is particularly useful on lighter soils subject to drifting. Flax is a poor weed fighter and should be seeded on clean land. **Flax stubble gives poor protection against soil drifting.** On soils subject to drifting farmers are getting good results by seeding flax on summerfallow and wheat on flax stubble.

Durum wheat is suited to most parts of the brown and dark brown zones. Rape seed production is hazardous in these zones because of its low drought resistance.

Forage crops and a livestock enterprise should be the basis of production on sandy soils, rolling land and other land unsuited for grain. Cultivated land should be utilized to produce annual hay crops where feed reserves are limited. Production of adequate feed for the livestock enterprise will give better returns than cash grain production.

THE BLACK SOILS

The black soil region has better moisture efficiency and cropping systems can be more intensive. Summerfallow costs are high, making returns from longer rotations greater than from the standard two-year rotation.

Grain production is the main business on the better black soils. Wheat, oats, barley and flax are the best grain crops. Rape, rye and peas in local areas are important secondary crops.

Yields of stubble crops in the black soil zone can be maintained by the use of legumes and commercial fertilizer. If nitrogen levels are kept high by fertilizer and legumes, the major needs for good stubble yields are good seeding and weed control.

Black soils are well adapted to growing forage crops. Use of legumes and grass-legume mixtures for soil improvement is warranted on most farms. Forage crops help to control weeds, protect soil against erosion, result in better soil tilth and serve to stabilize farm income.

Forage crops are particularly important on sandy soils and farms with large areas of "bluff podzols." (See Soils Section page 23.) They are especially good in areas of uneven topography where grain growing costs are high.

The amount of forage sown should be based on feed requirements, soil type and soil condition. A combination of sweetclover, which is adapted to short rotations and grass-alfalfa mixtures for longer rotations is recommended. This can be developed into a good cropping program for soil improvement and feed production. Several rotations may be in operation on any one farm.

Sweetclover can be used as hay, pasture, seed or green manure. Where used for seed, summerfallow may be needed after sweetclover. If broken early or green-manured sweetclover land can be cropped the next year. Alfalfa grass mixtures should be left down for 2 to 5 years and rotated with grain. The use of the short term sweetclover-grain along with the longer rotation allows the regular use of legumes on all land.

Results of long term tests at the Experimental Farm, Indian Head, show the benefit of legume-grass mixtures in the rotation. Grain yields in the rotation with grass-legume mixtures have tended to increase. In the grain rotation yields are declining and weed control is a much greater problem.

At Yorkton, wheat yields on summerfallow in a three-year rotation have averaged 22.9 bushels per acre compared to 27.6 bushels per acre in a rotation including legume-grass mixtures.

GREYISH BLACK AND GREY SOILS

Forage crops should form a definite part of all rotations on greyish black and grey soils. The acreage devoted to forage crops should be about 25 per cent on the better degraded black soils. On the sandy soils and some of the poorer grey soils, forage crops and livestock should be the main enterprise. Forage should be planted on 60 per cent or more of the crop acreage.

In northern and northeastern Saskatchewan the percentage of wheat in the three top grades is usually well below the rest of the province. Barley and oats are better adapted to the growing conditions in much of the area. The coarse grains also compete better with weeds.

Yields at Whitefox on a fine sandy loam soil, show the value of legumes and grasses for northeastern Saskatchewan. (Table III.)

In the straight grain rotation yields are decreasing; whereas in the grain-forage rotation they have tended to increase each year. The net profit over a 23-year period has been $3.12 per acre for the three-year rotation and $10.71 for the six-year rotation.

TABLE III

COMPARISON OF YIELDS FROM 2 ROTATIONS AT WHITE FOX

Wheat on summerfallow in 3-year grain rotation	21.9 bushels per acre
Wheat on summerfallow in 6-year rotation including grass-alfalfa	*34.6 bushels per acre
Oats on wheat stubble in 3-year grain rotation	29.2 bushels per acre
Oats on wheat stubble in 6-year rotation	45.9 bushels per acre
Hay Yields—First year	1.49 tons per acre
Second year	1.49 tons per acre

*The hay mixture in this rotation is alfalfa and slender wheat, left down for 2 years.

CULTURAL PRACTICES

TILLAGE

Tillage costs make up a large part of the total cost of producing crops. By using the right implement, properly adjusted, at the right time, this cost can be kept to a minimum.

The main reasons for cultivation are moisture conservation, weed control and seed bed preparation. Tillage may help in the control of insects or disease. (See sections on Insects and Plant Diseases.) Too much and careless cultivation is a major cause of wind and water erosion.

Summerfallowing should be started early in spring to kill early weed growth and prevent surface drying. (See Table II.) Disc implements should not be used on light stubble. Where perennial weeds are a problem and the season wet, the discer or one-way may be needed for weed control. Disc implements should not be used more than needed for weed control or trash handling on any soil. Disc implements powder the soil and cause soil drifting. (See Soils Section page 12.) Harrows also powder the soil and should be used with caution.

The heavy duty cultivator or the blade cultivator should be used for a large part of summerfallow work. The heavy duty cultivator can be fitted with the right shovel for weed control in any soil. The blade cultivator is the best implement for light soils in all regions.

The rod weeder combines well with the cultivator on summerfallow. After one operation with the cultivator at four inches the rod weeder may be used for two or three operations on summerfallow. It is cheap to operate and keeps the trash cover on top. The rod weeder should not be run too shallow for fall work on summerfallow. If run too shallow, soil is powdered and trash is loose on top. The heavy duty cultivator with rod weeder attachment combines the two machines in one. It gives better weed control and leaves more trash at the surface than the cultivator alone.

Cultivation should normally be from three to four inches deep. Very shallow tillage gives poor control of perennial weeds and causes pulverizing. Tillage deeper than four inches is costly and usually is of little benefit. There are very few places in Saskatchewan where there is any "hard pan" that will be improved by tillage deeper than five inches. Some variation in the depth of tillage using the cultivator at four to five inches will correct most hard layers. Where soil has become very hard, the only way to improve it is to plant grass or grass-legume mixtures.

Late fall tillage on summerfallow is justified only for control of perennial weeds or winter annuals like stinkweed. **Stinkweed may be sprayed in the late fall.** (See Weed Section.)

Stubble land should be worked in the fall only for the following special reasons:

1. Perennial weed control (see Weed Section).
2. Insect control (see Insect Section).
3. Germination of weed seeds (e.g. wild oats). (See Weed Section.)
4. Reducing trash cover for seeding.
5. Improving a puddled soil surface.
6. Killing heavy weed growth.

Fall tillage does not increase the yield of stubble crops in most areas. When fall working of stubble is necessary use the cultivator to leave the stubble standing to trap more snow.

SEEDING

Pre-seeding tillage on summerfallow generally increases yields. When seasonal conditions permit, a delay following this operation to allow one crop of weeds to be killed gives cleaner crops. This has given higher yields in some cases but under dry conditions, the surface may get too dry for germination. The cultivator, springtooth harrow, or cultivator and harrow are best for pre-seeding tillage. The discer is good for pre-seeding tillage where moisture is satisfactory and soil drifting is not a problem. Tillage before seeding should be no deeper than the desired depth of seeding.

The press drill is the best implement for seeding summerfallow on most soils. The standard double disc drill is better for heavy soils where clay sticks to the press wheels. The flexi-coil type of packer behind the drill or other packers a half day or so later can be used for packing. For firm summerfallow on heavy soils the discer or one-way and packer give good results. Experimental results at Regina show that pre-seeding tillage may not be beneficial where the discer or one-way is used for seeding on clean summerfallow.

Preparing stubble land for seeding should start with uniform straw spread-

ing at harvest time. The oscillating harrow, used when straw is dry, is the best implement for completing the spreading job. Following the oscillating harrow, the heavy duty cultivator mixes a good part of the straw with the soil while leaving stubble standing. Burning straw is a waste. Where crops are heavy, every effort should be made to bale straw for livestock use.

The one-way and discer have given good results for seeding stubble land, but packing is absolutely necessary. On sandy land, the plough and pony press drill normally give best results.

On a poorly prepared seed bed, no method of seeding can give good results. The seed bed should be moist, level, firm and should not be pulverized. On loose summerfallow, the rod-weeder or packer before seeding may help firm the seed bed for better depth control.

Seeding depth need be no more than enough to place the seed in moist soil. Seeding depths should be no greater than three inches for wheat and coarse grains if sowing into moist soil. Flax and rape should not be seeded deeper than two inches in moist soil. Since forage crop seed should be seeded less than one inch deep, it should not be seeded with the grain. Where forage crops are seeded with a companion crop they should be seeded after the grain and at right angles to the grain rows. (See Forage Crops Section.)

A three-year seeding depth experiment on barley at Star City carried out by the University of Saskatchewan gave the following results.

Seeding Depth	Yield
1 inch	46.7 bushels per acre
2 inches	43.9 bushels per acre
3 inches	36.1 bushels per acre

Rates of seeding should be guided by results in the local district. In general, lighter rates are satisfactory in the brown and dark brown soil zones, heavier rates are better in the black, greyish black, and grey soil zones. Heavier seeding provides better competition with weeds and may give better stands on stubble. Ranges in seeding rates are as follows:

Wheat	1	to 2	bushels per acre
Oats	1½	to 3	bushels per acre
Barley	1½	to 2½	bushels per acre
Rye	¾	to 1½	bushels per acre
Durum Wheat	1½	to 2½	bushels per acre
Flax	28	to 40	pounds per acre
Rape	5	to 10	pounds per acre
Peas	1½	to 3	bushels per acre
Beans	1½	to 2	bushels per acre

Dates of seeding are controlled largely by seasonal conditions. Very early seeding on cold wet land is not wise. Delayed seeding is the best practice for wild oat control but late seeding usually results in lower yields. On the average in southwest Saskatchewan, yields of oats and barley are reduced when seeded after May 10th.

Experiments at Regina indicate that except when delayed seeding is advisable for wild oat control, wheat should be seeded as early as a good seedbed can be prepared, or within a week of that date, depending on the temperature. A good time to start seeding is when the first signs of weed growth appear. Oats and barley should be seeded immediately after wheat. Barley can be seeded as late as May 20th without a reduction in yield, whereas yields of wheat and oats decline as the seeding date is delayed. Usually flax has given highest yields when sown between May 16th and 23rd.

At the Experimental Farm, Scott, highest yields of wheat, oats and barley were obtained by early spring tillage followed by seeding 10 days later, for the period 1948 to 1958.

In east and north Saskatchewan, short-term averages show no serious reduction in coarse grain yields unless seeded much later than June 1st. Results on wheat are somewhat similar. Over a 13-year period at Indian Head, average yields of wheat were 33.4 bushels seeded May 1st; 32.7 bushels seeded May 10th; 32.2 bushels seeded May 20th, and 28.4 bushels seeded May 31st.

In districts where early fall frost is a hazard, wheat seeding should not be delayed.

THE IMPORTANCE OF GOOD SEED

Seed drill surveys in recent years show much seed wheat in Saskatchewan would grade rejected because of weed seeds. Oats and barley are much worse. In addition, many farmers are using varieties of oats and barley not suitable for their district.

Seed costs are only a small part of the total expense of producing a crop. Use of good seed improves the possibilities of high yields.

Every farm should have a special plot growing seed each year. A fertile plot reasonably free of weeds should be selected. Extra care controlling weeds and harvesting will ensure high quality seed. Occasional use of registered or certified seed is advisable to provide

seed stock true to variety. Seed should be cleaned and graded thoroughly.

Seed should be treated for insect and disease control where necessary. (See Sections on Plant Diseases and Insects.)

Germination and smut tests may be obtained free of charge through certain of the elevator companies. If no bunt is present, it is not necessary to treat wheat for smut control. If germination is between 65 and 85 per cent, the seeding rate should be increased accordingly. Seed germination less than 65 per cent is unsatisfactory.

The germination of forage crop seed may be reduced with age or poor storage. Where germination of forage seed is unknown, an official test should be obtained. Such tests are carried out on all types of seeds by the Plant Products Division of the Canada Department of Agriculture at 413 London Building, Saskatoon, Saskatchewan. The charge is $1.00 for forage seeds and 75 cents for grain.

HARVESTING

Careful harvesting is needed to bring in all the ripened crop. Adjustments for harvesting equipment are covered in the section on farm machinery. (See page 39.) (See, too, Reading List at end of this section.) A guide to the efficiency of threshing is the fact that about 20 kernels of wheat per square foot represents one bushel per acre.

Swathing or cutting wheat with the binder should be started when the grain has 35 to 40 per cent moisture. Wheat is ready if the kernel is firm but easily dented by the thumb nail.

Earlier swathing may be advisable where there is danger of frost or where sawfly damage occurs. To reduce sawfly damage, swathing should begin when infested stems start to break over.

Malting barley should be ripe before swathing. It should be combined as soon as dry. Green or damaged kernels cause degrading of malting barley.

For safe storage, threshed grain should not have more moisture than allowed for straight grade. The highest moisture percentages allowed for straight grades are: wheat 14.5, durum wheat 14.8, oats 14.0, barley 14.8, rye 14.0, flax 10.5, and rapeseed 10.5. Complete information on harvesting special crops such as flax and rape is available from the agricultural representative or experimental farm in your district.

Straw spreaders should be used on the combine. Poor straw spreading results in difficulties during later cultivation.

SEQUENCE OF GRAIN CROPS

In grain rotations, oats and barley produce better on stubble than wheat. Oats and barley compete better with weeds which are usually more of a problem on stubble. Experiments at Regina show that wheat on summerfallow after second crop oats yields better than wheat on summerfallow after second crop wheat. Similar results have been obtained by the Experimental Farm at Brandon. Nitrogen fertilizers improve yields of oats and barley on stubble more than wheat.

Root rots and leaf diseases have increased in recent years. Some control may be gained by using both coarse grains and wheat in the rotation. (See Plant Disease Section.)

Diseases which winter over on stubble are particularly serious on flax and barley. Flax and barley should not be seeded on the same land two years in a row. It may be advisable to arrange fields to keep flax or barley away from neighbouring fields of flax or barley stubble. (See Plant Disease Section, page 94.)

GRASSES AND LEGUMES IN THE FARM PROGRAM

Forage crops serve a two-fold purpose on the farm. Grass and legume hay provides the best and cheapest feed supply for livestock. On many farms the use of grasses and legumes is needed for soil maintenance. Thousands of acres of sandy soil, slightly "alkali" soil and rolling land in Saskatchewan would give better returns if seeded to long term hay or pasture mixtures.

Soil condition is probably a greater problem in Saskatchewan than soil fertility. Better condition or tilth is best obtained by using legumes and grasses in the rotation. Legumes not only build up the supply of organic matter but add nitrogen to the soil. A year's growth of sweet clover or alfalfa may contain as much nitrogen as ten dollars worth of commercial nitrogen fertilizer. Almost two-thirds of this is obtained from the air by root nodules.

Although the use of legumes and grasses is most important on unproduc-

tive soils, it is a mistake to put them only on poor soils. Returns from grass-legume hay and pasture on some of the best soils are greater than returns from grain.

Heavy crops of hay and pasture remove large amounts of nitrogen, phosphorus and other elements from the soil. More attention should be given to fertility and management of hay and pasture land. (See Soils Section page 18 and Forage Section page 61.)

Alfalfa and sweet clover are the most important legumes in Saskatchewan. Alfalfa should generally be grown in mixtures with grass for hay and pasture. Under irrigation, in areas with a high water table, or for sale to dehydration plants, straight alfalfa may be used satisfactorily. Pure alfalfa is, however, more difficult to cure for hay than alfalfa-grass mixtures.

On very sandy soils, slightly "alkali" soils, steep slopes and other problem areas, land should be left in grass-alfalfa as long as yields can be maintained. Except in more moist areas, a partial summerfallow after taking off a hay crop does not result in a good cereal crop the following year. Farmer experience shows that oats or flax is more satisfactory than wheat after a partial fallow. For best grain yields a full year's summerfallow should be given to sod-breaking. Wireworms often cause severe damage on sod-breaking. Chemical seed treatment gives good control. (See Insect Section, page 109.)

Sweet clover is a valuable green manure crop particularly in the northeast and can be used for silage, hay or pasture. When sweet clover is used as a green manure crop, it should be worked down with the one-way when it is 10 to 12 inches high. In drier areas, early working is necessary to allow for moisture conservation.

Sharp discs on the one-way are needed to work down sweet clover. The heavy duty cultivator followed by discer also works well.

Sweet clover also gives high yields and is one of the best crops for silage. It is a good short-term pasture. When yield and price are favourable, fair returns may be obtained from a seed crop. If sweet clover is used in any way improvement in soil condition and crop growth usually result. The sweet clover weevil is the most important problem in the use of sweet clover. It can be controlled by spraying. (See Insect Section page 116.)

The best return from forage crops in the farm program can be obtained by feeding them to livestock. High quality hay and pasture supply the cheapest and best feed for cattle. Livestock, grasses and legumes are the basis of the cheapest fertility program on a farm. Barnyard manure is not only a good fertilizer but supplies organic matter of the best type for soil improvement. About 70 per cent of phosphorus fed to livestock is recovered in the manure. Other plant nutrients are returned in much the same amount. The effect of barnyard manure is shown by trials at Parkside, Snowden and Star City. Over a twenty-three year period at Parkside an application of 12 tons of barnyard manure per acre every four years, has increased the yield of wheat on summerfallow by 6.6 bushels per acre. For eleven years at Snowden and 8 years at Star City, 12 tons of barnyard manure applied once in three years has increased the yield of wheat on summerfallow by 16.6 and 6.5 bushels per acre at the respective stations. These two stations are on grey-wooded soil.

Although increases may not be as great in all areas, barnyard manue is one of the best treatments for unproductive soils. Eroded soils, limy knolls, "alkali" spots and grey soils show the best results from manure.

Grass seed production is a profitable secondary enterprise. Nitrogen fertilizer, weed control and management are all needed for high yields. Where livestock is not kept, a combination of a short rotation including sweet clover with some acres in grass for seed production can make a balanced program.

The market for quality hay has increased in recent years. On the black, greyish black and grey soils, hay production can be profitable. Even in the brown soil zone, well managed tame hay produced an average of nearly one ton per acre at Swift Current from 1943 to 1954.

Recommendations in this section are general. For more detailed information for specific areas, consult your local Agricultural Representative or Experimental Farm.

Farm Equipment and Buildings

The Agricultural Machinery Administration conducts functional and durability tests on farm implements offered for sale in Saskatchewan. Reports of these tests are available from Agricultural Machinery Administration at 7th and Hamilton, Regina or the local Agricultural Representative.

FARM TRACTORS

The main considerations in tractor selection are the size and type of engine and kind of traction. This table compares the costs of operation of tractors of equivalent drawbar horsepower using various fuels and based on the following prices.

AVERAGE FUEL COST

Type of Engine	Fuel	Wt. lbs. per gal.	Price per gal.	Lbs. fuel per D.B. H.P. hr.	Cost in cents H.P. hr.
High Compression*	Bronze purple gasoline	7.3	25	0.579	2.0
Low Compression	Purple gasoline	7.3	24	0.720	2.4
Standard tractor converted to L.P. gas	L.P. gas	5.5	17	0.565	1.8
H.C.-L.P. gas	L.P. gas	5.5	17	0.510	1.6
Diesel	Diesel Fuel	8.4	20	0.498	1.2

* See Agricultural Extension Bulletin No. 81, Engine Fuels.

The average tractor on Saskatchewan farms is used 450 hours per year. When a tractor is used more than this the saving in the cost of Diesel fuel over gasoline will justify the added cost of the Diesel tractor of comparable horsepower. When the difference in purchase price between the same size Diesel and gasoline tractors is less than $700, the Diesel can be justified with fewer hours per year.

The use of liquid petroleum (LP) gas can result in less engine repair costs. A saving in fuel costs may be expected when the cost per gallon is about one-third less than gasoline and about one-fifth less than diesel fuel. Local fuel supply and servicing facilities are important considerations when purchasing farm tractors.

The average gasoline tractor operates most efficiently at or near its rated load, approximately 75% of Maximum. Fuel consumption per horsepower hour increases rapidly as the load decreases. At one-fourth load the fuel consumption per horsepower hour may double the consumption at rated load. Diesel efficiency changes very little as the load decreases.

Overloading reduces the power output of the tractor, increases loads on bearings and increases wheel slippage. The tractor with a large choice of ratios enables selecting a speed suitable to the load pulled and the power output of the engine.

Fluid type transmissions provide an automatic means of increasing pounds pull at reduced speed, however, fuel efficiency will be lowered accordingly.

The drawbar pull that a tire can transmit depends primarily on the weight that it carries and not the tread design. For general farm work a rubber tired tractor will pull approximately one-half the load carried on the driving wheels. Tires can be weighted by fluid and adding wheel weights but must not be loaded beyond the manufacturer's recommendations. Calcium chloride solution should be used when filling tires to protect them against frost damage. Tire pressure should always be sufficient to prevent excessive sidewall flexing. Front tires may require weights to improve steering and prevent lifting.

Four wheel drive and track type tractors operate with less slippage than two wheel tractors and are desirable on soft footing and hilly land.

When power requirements exceed 50 D.H.P. the use of track type or four wheel drive tractors should be considered. Power can be saved by drawing larger sized units at slower speeds. Slower speeds will often provide better tillage.

Agricultural rubber tires are not designed for speeds over 15 m.p.h.

Front end attachments should be mounted on tractors with heavy duty front axles and adequate tires to carry the additional load. Power steering is an advantage and standard type tractors are generally preferable to row crop types.

Bucket or fork capacities must not be

larger than the rated carrying capacity of the axles and tires. Light model loaders are not generally suitable for rock handling or earthwork. Allowable weight limits will also determine the selection of snow plows and similar front end attachments.

Information on Nebraska Horsepower ratings for tractors is available from the University Agricultural Engineering Department or your Agricultural Representative.

DRAFT AND HORSEPOWER REQUIREMENTS

(Level to slightly rolling land)

Implement	Soil Texture	Average Depth	Average Speed (m.p.h.)	Draft/foot of width	H.P./foot of width
Plow—slow speed moldboard	Sandy loam to clay loam	4.5"	3.25	370-470	3-4½
Plow—high speed moldboard	Sandy loam to clay loam	4.5"	4.5	350-425	4-5½
Disc—Plow	Clay	5"	4.25	550	5½-6½
Discer	All soils	3"	4	105-165	1½-2
One-way Disc	Loam to Clay	3½"	4	165-250	1¾-2¾
Cultivator Duckfoot	Loam to Clay	3½"	4	130-180	1½-2
Cultivator heavy duty	Loam to Clay	3"	4	150-250	1½-3
Cultivator heavy duty	Loam to Clay	3"	5	175-300	2½-4
Cultivator heavy	Loam to Clay	4"	4	225-350	2½-4½
Cultivator blade sweeps	Loam to Clay	3½"	4.5	140-210	1¾-3
Blade	Loam to Clay	3½"	4	170-300	1¾-4
Blade	Loam to Clay	3½"	5	180-350	2½-4¾
Rod-Weeder	Loam to Clay	3"	4	75-125	¾-1½
Drill-double disc	Loam to Clay	3"	4.5	55-60	¾-2
Press Drill	Loam	3"	4.5	60-80	¾-1
Hoe Press Drill	Loam	3"	4.5	95-115	¾-1½
Packer-sub surface	All Soils	—	4.5	30-40	¾-1
Drag Harrow	All Soils	—	4	30-40	1/3-½
Oscillating harrow	All Soils	—	4	40-50	½-¾

1. H.P. requirements for hilly land should be increased approximately 25%.
2. Soil type does not affect draft of the discer to any extent.
3. Discers with large diameter discs will have higher draft.
4. The above figures are averages and may vary due to soil and moisture conditions; the lower figures pertain to the loam soils and the higher figures to the clay soils.

LUBRICATING OILS

Multi-Viscosity Oils

Multi-viscosity oils were developed primarily for use where a wide range of temperatures were encountered during the period of operation. These oils provide adequate lubrication during cold starts and have sufficient lubrication qualities for high speed operation.

The following classification of lubricating oils has been approved by the American Petroleum Institute and the Society of Automotive Engineers. The viscosity numbers are retained with each classification.

SERVICE CLASSIFICATION	OPERATING CONDITIONS
Service M.L. (Motor Light) formerly called "Regular"	For moderate speeds and moderate engine temperatures. May be used in old model, low compression engines on light loads. Not suitable for high compression engines or those with hydraulic valve lifters.

Service M.M. (Motor Medium) formerly called "Premium"	For high temperatures, light duty operation such as long distance driving with few stops, gasoline tractors on light loads, or trucks on long hauls with light loads.
Service M.S. (Motor Severe) formerly called "Heavy Duty"	Used for start and stop service in which low temperatures and light loads can cause corrosion, oil ring plugging, cold sludging and fuel varnish deposits such as city driving and delivery trucks. Also heavy continuous loads such as trucking with heavy continuous loads.
Service D.G. (Diesel General) formerly called "Heavy Duty"	For Diesel engines operating on low to moderate sulphur content fuels of normal volatility under normal operating temperatures and load. This type of service is typical Diesel farm tractor operating conditions.
Service D.M. (Diesel Medium) formerly called "Heavy Duty"	Service typical of Diesel engines operating under severe conditions or using fuel of a type normally tending to promote deposits and wear but where there are design characteristics or operating conditions which may make the engine either less sensitive to fuel effects or more sensitive to residues from lubricating oil.
Service D.S. (Diesel Severe) formerly called "Heavy Duty"	For Diesel engines in low temperature service which may result in soot and cold sludging, and in Diesel engines under very high load. Also used in certain makes of Diesels as recommended by the manufacturer.

CARE OF FARM MACHINERY

The operators' manual supplied with each machine is the best guide to successful operation, adjustment and repair of that machine. The recommended care, adjustment and lubrication is the best and cheapest insurance against trouble or failure of the machine.

To obtain the long life expectancy built into farm machinery it is important to provide care when not in use.

1. When finished with a machine or piece of equipment, clean it thoroughly.
2. Check the entire machine for worn, broken, or bent parts and order repairs immediately.
3. All bearings should be thoroughly greased.
4. Protect polished surfaces from rust by covering thoroughly with a heavy bodied grease or commercial rust preventative.
5. When machines are properly housed the belts should be slackened and canvasses removed. Canvasses painted with red oxide barn paint (not lead base paints) on grain side will last much longer. Machines stored outdoors should have belts, canvasses and reels removed. Park machines away from buildings to minimize snow bank damage. Adequate painting is desirable on all machines.
6. When tires are left on machines for long periods, the load should be removed. Tires should be coated with a tire paint and left inflated.
7. Protect machinery from livestock and poultry.
8. Drain radiators, fuel tanks and carburetors and cover motor openings against moisture and dust.
9. Oil each combustion chamber of the engine thoroughly through the spark plug openings and replace the plugs.
10. The crankcase oil should be changed and the filter replaced before putting a motor into winter storage. Running the motor for fifteen minutes after the oil change will insure a coating of fresh oil on all bearing surfaces.

TILLAGE MACHINERY

Tillage should attain the following objectives: moisture conservation, weed, insect and soil erosion control. The quality of work done depends upon the soil-moisture content and the condition and operation of the machine. The depth of tillage is measured by laying a straight edge on the unworked land and measuring the actual distance to the bottom of the cut. See Cropping Practices, Insect Pests and Weed Control Section for details.

A good trash cover protects and improves soil.

Disc equipment includes one-way discs, discers and disc harrows. To select the size of machine suited to the tractor refer to the draft and horsepower table on page 34.

Speeds in excess of 4 m.p.h. should not be used under dry conditions. Owners of large tractors may find it more practical to pull two small machines rather than one large machine. Machines equipped with small diameter or shallow concavity discs will require less power than machines equipped with large diameter or deep concavity discs.

Better penetration can be achieved by means of a deep concavity disc; by adjusting the machine to a narrow cut and operating it at slower speeds. In hard ground the rear wheel usually requires extra weight; in some cases weight should be added to the entire machine; the width of cut should also be decreased.

For tillage in heavy trash the discs should be sharp, widely spaced and of large diameter to provide the additional clearance required.

For details see bulletin "Maintenance and Operation of Tillage Machinery."

Cultivators are the most widely adapatable of all tillage implements to soil conservation and erosion control.

The duck-foot cultivator can only be used successfully where the soil and trash conditions are such that a constant depth of tillage may be maintained. Heavy duty and tool bar cultivators are recommended for heavy trash or hard soil conditions.

The clearance of the blade cultivator or weeder allows it to operate under heavy trash conditions. It will maintain a good trash cover even after repeated operations. Satisfactory weed kills are difficult to obtain under moist conditions. These machines are primarily designed for operation in light to medium textured soils and do not perform well in clay soils unless dry or firm. Rod weeder attachments for heavy duty cultivators will provide good weed and soil erosion control.

The following types of shovels or sweeps are recommended for tool bar and heavy duty cultivators. They are not generally available for duck-foot cultivators.

Low lift shovel (¾")* used in moist sandy or dry loam soil.

Medium lift shovel (1")* used in moist loam or dry clay soils.

High lift shovel (1¼")* used in moist clay soils or for strength in stony land.

For further details see bulletin "Maintenance and Operation of Tillage Machinery."

Plows.—For details on the moldboard plow see the above bulletin.

Harrows.—Diamond drag harrows will kill small weeds, level and pack soil after seeding. Not satisfactory in trash cover.

Flexible harrows are equally effective in weed killing and packing in trash cover but have less levelling effect.

*Relative lift of shovel, measured at the heel, when it is resting on a level surface.

The oscillating harrow will work in extremely heavy trash conditions and is effective in spreading straw.

Stone Pickers.—These machines work satisfactory only when the stones are on the surface and the soil is dry, firm and devoid of trash.

Mounted implements provide tillage at lower draft per foot of width than similar pulled implements. Wide mounted implements with depth regulating wheels and flexible features provide even penetration under most field conditions.

Farm scrapers which can be pulled with a farm tractor are useful implements for farm earthmoving such as ridge removal, ditch filling and grading. Two wheel, open bottom scrapers of six to ten feet width and operated with hydraulic controls are available.

Heavy Duty Machines.—Heavy duty offset or "inthrow" "out-throw"disc machines with 26"-30" diameter discs are designed primarily for use after brush breaking or in heavy stubble. Cut-away types of blades are available on this machine for use in cutting small woody growth.

The offset type leaves the land level while the out-throw type causes considerable ridging. On the other hand, the out-throw type will penetrate much more readily.

The power requirements are high depending on the angle of cut and the inherent weight of the machine. In general approximately 5-7 rated drawbar H.P. per foot of width is required.

SEEDING MACHINERY

Grain Drills.—The double disc drill seeds at a uniform depth and covers without excessive loosening of the soil, provided the same tension is maintained on all the pressure springs. Where soil drifting is prevalent and the soil is easily pulverized, cover chains should not be used. Research information indicates that under light soil conditions yield increases warrant the use of the press drill.

On moist heavy clay soils the use of rubber faced press wheels will permit the use of press drills. Hoe type press drills permit their use in heavy trash cover. The draft of the press drill is higher per foot of width than the double disc drill. Difficulty may be encountered with the press wheels when operated on excessively moist heavy clay soils. The draft is slightly higher per foot of width than with the double disc drill.

Grass and legume Seeding Equipment.—The conventional grain drill or press drill equipped with a depth control device mounted on the furrow opener will seed at a uniformly shallow depth. Some degree of depth control may also be secured by releasing the pressure springs on the furrow openers or packing the soil before seeding.

When seeding small forage seeds with the internal double run feed, the rate of seeding should be checked. It may be necessary to mechanically reduce the speed of the feed shaft even more than that which is provided for on the machine.

Seeding with Disc Type Implements.—Desirable for seeding stubble crop where the seed drill has difficulty in penetrating heavy trash. On medium to heavy soils their seeding performance on summerfallow is equal to other standard equipment.

The seed spouts should be adjusted to deliver the seed in the bottom of the furrows at a uniform depth. These machines are most useful in areas where fields are reasonably level and uniform in soil type. Disc machines should be set sufficiently narrow to insure a complete weed cut provided the seed is not placed too deeply.

Seeding with Blade Type Implements.—Seeding attachments for blade type implements are being used for seeding through heavy trash, in areas where soil erosion is a serious hazard.

Packers.—The packer promotes rapid and uniform germination by bringing the soil and moisture into close contact with the seed. Packing is most useful immediately following seeding, especially where seeding has been done with a one-way disc or discer. When seeding flax and forage crops in loose soil packing may precede seeding. The packer must be of heavy construction or heavily weighted for satisfactory results.

The spiral packer is most effective when operated behind the one-way or discer with seeding attachment.

Under some conditions drag harrows, flexible harrows, or rod weeders may be effective for packing as well as weed killing after seeding.

Surface-type packers with flat faced wheels are not recommended because they pulverize the soil.

Fertilizer Attachments.—Commercial fertilizer should not be mixed with the

seed for drilling as it will corrode the metal parts of the drill and cause excessive wear. The fertilizer attachment overcomes this difficulty. Care should be exercised to prevent moisture getting into the fertilizer box. A waterproof cover for the box will reduce the possibility of caking. Even in the latter case the fertlizer must be cleaned out of the hopper when seeding is finished. Commercial fertilizer may be handled in bulk using small grain augers at about one half their normal capacity.

Some fertilizer attachments now on the market do not have the capacity to handle the high rates of fertilizer recommended for forage and stubble crops. Caution should be exercised in purchasing a new attachment. Large (lime spreader) type fertilizer spreaders are available and are recommended for supplying very high rates of fertilizers.

Specially designed machines are now available for the application of anhydrous ammonia. The cost of these machines is relatively high and most applications are done on a custom basis. (See Fertilizer section.)

Calibration of Grain Seeding Machinery.—The rates of seeding for grain can be checked in the field by filling the seed box level full, then seeding for a measured or known distance and measuring the amount of seed required to refill the box level full. Knowing the measured width of the machine, the distance travelled, the amount of seed used and the area covered, the rate of seeding may be calculated as follows:

$$\frac{\text{Width in inches} \times \text{miles travelled}}{100} = \text{acres covered}$$

$$\frac{\text{Seed used (in bushels)}}{\text{Acres seeded}} = \text{rate per acre}$$

The indicators that are supplied with seed drills are frequently unreliable. The indicators on seeding attachments for disc type implements are only calibrated for one angle of cut. For the above reasons, it is necessary to field calibrate all seeding equipment. For greater accuracy, feed runs should be calibrated individually, by attaching a bag to each spout, the machine is then operated a given distance.

For the seeding of Forage Crops see bulletin on Hay and Pasture Crops for Saskatchewan.

SEED CLEANING MACHINERY

In cleaning seed there are three distinct separations:

These separations are actually made through three basic differences between the seeds or kernels and the rejected materials by differences in (1) width, (2) length, (3) weight.

Separations may be made in combinations of two or more of the following cleaners, one of which must be a Carter disc or an indent cylinder machine.

1. Fanning Mill
2. Fanning Mill with Corrugated Rolls
3. Corrugated Roll Grader
4. Carter Disc
5. Indent Cylinder
6. Combination Scalper and Grader

A recommended farm grain cleaning unit consists of a 40-inch or larger improved fanning mill used in combination with a small Carter disc machine. The machines may be mounted on a platform with suitable elevators to provide for continuous operation. The fanning mill may be mounted high enough to deliver its cleaned grain directly into the hopper of the Carter disc. Higher capacity and smoother operation may be obtained by mounting the engine on a separate platform or on the ground.

Custom operated or Co-operative grain cleaning plants, such as those now in use in many Saskatchewan centres, are highly recommended. The practice of cleaning seed grain in country grain elevators is not recommended.

A bulletin on seed cleaning or further information on seed cleaning plants may be obtained from your Agricultural Representative or the Extension Department, University of Saskatchewan.

Machines are now available for applying dusts or liquids, or a combination of the two for disease and wireworm control.

Auger type grain loaders operated at approximately one-half their normal capacity may be used as a treating mixer provided an accurate means of proportioning the grain and chemical is used. Metering machines are now available as separate units or as attachments to the auger loader.

Caution.—Dusts and liquids are highly poisonous and care must be exercised in their use. Augers and equipment must be thoroughly cleaned before handling market or feed grain.

HARVESTING MACHINERY

Swathers.—Swathers permit earlier cutting of grain, thus reducing losses from insects and hail and eliminating problems of green undergrowth. The height of cutting will vary according to crop conditions but the stubble should not be more than eight inches in height. In light crops placing two adjacent cuts in one (double swathing) will provide a better swath. Canvas and reel speed should be equal to or slightly greater than the forward speed of the swather.

Three general types are available:

1. Power take-off pull type which may have either centre or inside end delivery.

2. Self-propelled type which is usually centre delivery.

3. Tractor mounted type. Both front and rear models are of the inside end delivery type.

Centre delivery swathers produce a criss-cross straw pattern with heads in the centre of the swath, whereas the end delivery type lays the grain at a slight angle to the direction of travel. Self-propelled swathers have advantages when opening fields, cutting around sloughs, etc. since they do not trample any standing grain. Initial costs for self-propelled machines are approximately double that of the pull-type models.

The tractor mounted swathers have some of the advantages indicated for the self-propelled types but often present problems at corners.

Combines.—Power take-off combines require a tractor of ample size to pull the combine as well as operate it at a maximum capacity without loss in cylinder speed. A live power take-off is recommended.

Engine driven combines require a tractor with a reasonable number of slow forward speeds.

Self-propelled combines have a wide range of forward speeds independent of the cylinder drive.

Essential Adjustments on All Combines and Threshers

1. The speed of the cylinder should be adjusted according to the manufacturer's recommendations (see operators manual).

2. Concaves should be adjusted so that the clearance between the concave and the cylinder is close enough to remove all grain from the head; avoid over-threshing.

3. The wind blast should be directed over the front ⅓ of the shoe. Fan shutters should be well open for wheat and coarse grain.

4. The openings of the adjustable sieve should be just sufficient to allow clean grain to pass through and unthreshed heads to pass over.

Tail-end losses may be checked by using the factor: 24 kernels per square foot over the whole width of cut is equivalent to one bushel per acre of average size wheat.

Combine Attachments

Grain Saving Guards and Pick-up Reel.—Grain saving guards (pick-up fingers) are valuable aids in saving lodged or tangled grain and may assist in saving sawfly damaged grain. Grain saving guards will not work well in crop which has lost its natural strength or started to rot.

The pick-up reel is composed of rows of rake-like fingers instead of the standard reel and batts. It is extremely valuable in badly lodged grain or grain that has been flattened by snow. It is essential that the speed and timing of the reel be correctly adjusted.

Grain Saving Guards and Pick-up Reels. are never used together.

Windreels are also available which can be installed in place of the conventional mechanical reels. In short crops they can reduce reel shattering and cutter bar losses.

Recleaners are available as optional equipment on most combines and are useful for removing weedseeds and cracked grain.

Strawcutters cut and spread the straw uniformly behind the combine. This permits the straw to be more easily worked into the soil. This attachment requires from 3 to 8 horsepower to operate and may necessitate a reduction in the forward speed of the combine.

Strawbunchers.—Where straw is required for livestock purposes, straw bunchers have been used with varying success. The common type of straw buncher collects the straw as it is rejected from the combine and deposits it in piles behind the machine.

Low density balers are available which attach directly to the rear of the combine and produce twine tied bales (rectangular). Horsepower requirements of these balers is about the same as that required for straw cutter attachments.

Grain Handling.—For greatest efficiency, grain augers should not be

operated at more than a 35° angle to the ground. The length of the auger should not be less than 30 feet. Six inch diameter augers are the most popular size.

Auger Tube Diameter	Approximate Capacity Bus/Min.	Recommended Gas Engine	Power Electric
6"	10	6 - 8	3 - 4
7"	25	9 - 11	4 - 5
8"	50	11 - 13	6 - 7½

The following table indicates the power requirements and the delivery capacity for the various auger tube diameters available.

GRAIN DRIERS

There are two basic types of portable driers available in Saskatchewan; the batch type which dries without moving the grain, and the recirculating batch type which dries while circulating the the grain. Propane is generally used to provide heat and the warmed air is moved by a blower powered by a farm tractor through P.T.O.

Caution must be exercised by the operator to ensure that the warm air remains below the temperature at which grain may be damaged. Grain to be used for seed should not be dried with air warmed to a temperature in excess of 110° F. whereas temperatures up to 160° for recirculating type and up to 135° for batch type driers may be used to dry milling wheat. Feed grain and oil seeds can be dried at still higher temperatures.

The capacity of most portable driers will vary from 65 to 110 bushels per hour while removing 5% moisture. When less moisture is to be removed the capacity of the machine will be greater. This does not include time to fill or empty the bin, nor cooling time.

The cost of propane for heating and gasoline for the tractor, will vary from 2½ cents to 3¼ cents per bushel while removing 5% of moisture at low temperatures.

Results of limited tests on available machines for drying wheat can be obtained from the Agricultural Machinery Administration.

It is possible to dry grain slowly by means of unheated air if weather conditions are favorable.

HAY AND SILAGE EQUIPMENT

Mowers. — Drawbar mounted, side mounted and trailer type mowers are available with either hydraulic or mechanical lifts. Where conditions are suitable, a satisfactory job of mowing can also be achieved with most types of grain swathers. Drying will be retarded where the swath is fairly heavy.

Serrated mower knives are available but are generally satisfactory only under dry conditions.

Rakes.—Dump rakes are satisfactory where hay is to be handled by sweep or hand methods. Where baler and forage harvesters are used it is desirable to use a side delivery rake which produces a uniform windrow. Several types of rakes are available with either power take-off or ground drive. The large wheel types cause less leaf loss damage to the hay.

Stackers.—Various types of sweep stackers are being used for handling loose hay. Some types are fully tractor mounted while others are mounted on two wheels and are pushed in front of the tractor. The ground should be relatively smooth and hauling distance less than one-half mile.

Balers. — Two types of balers are available; round twine balers and rectangular balers using either twine or wire. Wire costs slightly more than twine but is more durable for commercial handling. Round bales withstand weather in the field better than rectangular bales but are more difficult to stack.

Balers may be tractor drawn with either P.T.O. or auxiliary motor drive or may be completely self-propelled. Tractors with live P.T.O. are preferable for P.T.O. balers, particularly the round bale type. Uniform windows are desirable for satisfactory baling and double windrows are necesary when using round type balers.

Forage Harvesters. — Three general types of forage harvesters are available:

1. Reel type
2. Flywheel type
3. Flail type

Any of these machines will cut and chop either standing crops or forage that has already been cut and windrowed. The flail type will cut and windrow a crop for further curing. After curing the same machine will pick up the feed and load it onto a forage wagon. Adjustments can be made on most ma-

chines to regulate the length of cut. Efficient operation of the forage harvester requires that sufficient horsepower be available from the tractor to maintain full recommended speed at all times. The flail type machines are somewhat cheaper than the other types and can be adapted to various cutting operations with a minimum of adjustment.

Crimpers and Rollers.—Crimpers and rolers are used to shorten the curing period. These machines crush and flatten the plant stems which enables the stems and leaves to dry at a more uniform rate.

Bale Loaders and Elevators. — The mechanical arm type and the elevating conveyor type are the most popular of the machines used in picking up bales in the field. Some makes of balers have ejector attachments which make it possible to bale hay and eject it to a trailing wagon in one operation. Various other manufactured and home built devices are also used in picking up bales either singly or in bunches.

For stacking bales, the elevator conveyor is most commonly used. For placing bales in barn lofts, either the conveyor type or the ejector type work satisfactorily.

MISCELLANEOUS MACHINERY

Feed Processing Machinery. — Rollers and grinders are suitable for grain only, while most hammermills can be used for roughage as well as grain. Feed cutters can be used for roughage only and will handle any kind of forage either green or dry. Small feed processing equipment is available with electric motors. Sufficient horsepower must be available to maintain proper speeds at all times.

Operating costs per bushel may be about twice as much for a grinder as for roller or hammer mill. The initial cost of a hammer mill will be higher than for a grinder or roller. The capacity of any type will be reduced in proportion to the degree of fineness required. Fine grinding will reduce the capacity per hour to about one-third of that for coarse grinding.

Land Clearing Equipment.—Rotary mowers are available which can be operated by P.T.O. on a farm tractor. This equipment will effectively demolish weeds and woody growth up to 2 inches in stem diameter. Front mounted P.T.O. or motor driven rotary mowers are available with a circular saw attachment for cutting larger trees. Extreme caution must be exercised in handling rotary mowers. Material ejected from the mowers is dangerous to bystanders. Guards are necessary to protect the operator and tractor radiator. Lug tractors are generally used as the material left after the operation can be dangerous to rubber tires.

Large scale land clearing is most commonly done by Vee type blade cutters and toothed piler equipment mounted on crawler tractors. The brush is put into windrows spaced approximately 150 feet apart and burned. Weighted cable or chain equipment can be effectively used for swathing down brush. The size and density of the brush that can be handled by this method will depend upon the size of tractors available for towing the chain. Tree growth tends to break off much cleaner when temperatures are well below the freezing point. Following this operation, piling can be done with a brush piler although a dozer blade will produce a much cleaner job. Piling costs can be reduced considerably if brush is knocked down and allowed to dry for about two years, after which an effective burn can often be obtained.

Cleared areas can be broken with either breaker bottom moldboard plows or with heavy duty disc plows. Tractor mounted root rakes are also available although considerable hand picking is often necessary.

IRRIGATION EQUIPMENT

Ditchers.—Field ditches can be made with a single or double wing ditcher using a farm tractor. The single wing types require a plow furrow for the ditcher to follow. Double wing ditchers may have adjustable wings or moldboards and depth control by hydraulic or mechanical linkages. Double wing ditchers are mounted on steel wheels or rubber tires.

Levellers.—Farm levellers consist of a long framework and a bucket or blade which will cut off high spots and fill small depressions. Sizes are available which can be pulled by farm tractors and may be equipped with mechanical or hydraulic controls to regulate depth of cut. Bucket type scrapers for use with farm tractors can be used for limited cutting and filling but are not suitable for heavy earthwork.

SPRAYERS AND DUSTERS

Spraying and Dusting Machinery.— Spraying and dusting machines are available to apply chemicals for weed and insect control.

1. Low volume, low pressure (30 to 50 pounds) boom-type sprayers operate at speeds of approximately 4 miles per hour applying approximately 4 gallons per acre for weed and field crop insect control. These machines are truck, trailer, or tractor mounted, and driven from the tractor power take-off or by an auxiliary engine. They may be adapted to some other uses. Piston and roller type pumps should be used for applying wettable powders, and where high pressures are needed, for example—spraying for the control of warble flies.

2. General purpose sprayers apply chemicals at low pressure for weed and insect control and also for high pressure (200 to 500 pounds) spraying of trees, livestock, buildings and small patches of persistent weeds. See "Spraying and Dusting Equipment," "Insect Pests," page 122.

3. Tractor, truck or trailer-mounted duster units are used for applying chemicals for weed and insect control. These may be operated at higher speeds than those recommended for field sprayers.

4. Boomless sprayers are well adapted for roadside spraying.

5. Aircraft spraying of chemicals for weed and insect control has been successful on large fields and for areas that are difficult to cover with conventional equipment. Due to fuel oil being used as the carrier for herbicides and insecticides applied by aircraft, care must be taken to prevent uneven or high rates of application which may cause crop damage.

6. Booms may be attached to self-propelled swathers, harrow hitches and other machinery.

PUMPS

Pump Types. — The selection of a pump should be based on the head required together with other factors such as the properties of the liquid to be pumped. Factors such as abrasive and corrosive properties and liquid viscosity are most important in selecting a pump for a particular job.

Centrifugal Pumps are widely used for pumping water, milk, lubricants and chemical solutions. It is relatively simple, has high mechanical efficiency under favourable conditions, and can handle fluids containing solids in suspension. Disadvantages are that it is not self-priming, unless specially equipped, and high pressures cannot be obtained with single stage pumps. The centrifugal pump is used almost universally for sprinkler irrigation.

Gear Pumps are positive displacement units and are quite inexpensive and simply constructed. The chief disadvantage is that abrasive particles which may be present in the liquid quickly destroy the close tolerances that are necessary for the pumps to develop normal pressures. Gear pumps are not suitable for pumping wettable powders.

Vane Pumps have similar characteristics and limitations to gear pumps. Recently, metal vanes have been replaced by nylon rollers or vanes. This change has greatly increased the resistance to abrasion. For this reason, vane pumps with nylon rollers are now widely used for sprayer application.

Piston and Plunger Pumps are usually employed where pressure higher than that readily obtained with a rotary pump is desired. The barrels and plungers are subject to scoring by abrasive particles. Adaptability has been greatly increased by the use of ceramic and nylon plungers. Pumps so equipped may be satisfactorily used for pumping liquids containing abrasive particles.

Diaphragm Pumps have been used for many years for pumping materials containing a large proportion of solids, such as liquid manure. Recently they have been designed with metal diaphrams making it possible to use them at moderately high pressures. Tests have indicated that the life of this type of pump is many times that of rotary pumps when used for pumping such abrasive materials as wettable powders.

Helical Screw Pumps have shown that they are quite suitable for pumping manure, even in a semi-solid state. Liquid manure has also been successfully pumped from storage sumps into tank wagons by ordinary grain augers.

Hydraulics on Farm Implements.— With a few simple precautions hydraulic systems should give many hours of trouble free service. Cleanliness of the oil is of prime importance due to the precision fit of pumps, valves and pistons. Any clean non-foaming oil of SAE 10 or 20 viscosity should give satisfactory service.

Hydraulic pumps require a significant amount of power for their operation. On some of the larger tractors—up to 20 horsepower may be required at relief valve pressure.

A relatively new application of hydraulic power is the hydraulic motor. The hydraulic driven mower is an ex-

ample and it seems likely that many similar applications will appear. Factors such as their ability to provide variable speeds, slip clutch effect, and easy adaptation in almost any location, should result in increased use.

Truck Hoists

Several types are available:

(1) Single cylinder under body
(2) Double cylinder under body
(3) Single cylinder and roller
(4) Telescoping cylinder front of box
(5) Cylinder and cable front of box
(6) Hand hoist.

Three sources of power are used to drive the pump—the most common being a power take-off. A small number have an adaptation for driving the pump from the generator or water pump belt which eliminates the necessity of purchasing a P.T.O. The third source of power is an electric motor which has achieved only a very limited use in small trucks because of its limited power and heavy drain on the battery.

A.S.A.E. Standards

A series of over 40 standards and codes covering a wide range of agricultural equipment and practices has been approved by the American Society of Agricultural Engineers. The list includes standards for power take-offs, belt drives, etc., and data on irrigation equipment, grain storage, etc. A complete list and further information may be obtained from the University Agricultural Engineering Department.

ELECTRIC POWER AND EQUIPMENT

WIRING

Farm wiring must conform to the regulations of the Canadian Electrical Code. This information is found in condensed form in "Farm Wiring Requirements." This booklet is supplied at 50c per copy by the Saskatchewan Power Corporation.

The use of electricity on the farm may be expected to double during the first five years after power becomes available. Any farmstead wiring should include large service entrance boxes, provision for extra circuits and ample plug oulets to accommodate increase in demand. Extra capacity costs very little when provided in the original installation.

C.S.A. APPROVAL

All equipment and appliances used in Saskatchewan must be approved by the Canadian Standards Association. This approval ensures that electrical equipment is safe when properly installed but is in no way a guarantee of mechanical operation. Equipment which is approved will have the letters "C.S.A." followed by a number either on the name plate or on an attached tag. C.S.A. regulations are enforced by the Electrical Inspection Branch of the Saskatchewan Department of Labour. Refusal to discontinue use of unapproved equipment may result in the power supplier being ordered to cut off power service.

FARM SHOP EQUIPMENT

On farms served by electricity the farmer may use electrical tools to speed up his repair work. A small finestone tool grinder and a larger, more rugged grinder are basic in the repair shop. Each should be selected and used only for the purposes for which it is suited.

A farm welder for quick repairs is rapidly finding its place in the farm shop. Bulletins on the selection of the farm welder should be obtained from the Agricultural Engineering Department and studied carefully before a welder is purchased.

Electric drills of various sizes, soldering irons, power hack-saws, drill press, electric hoist and other equipment may be added to suit the needs and capabilities of the individual farmer.

Good quality equipment will pay dividends in satisfaction, long life, and low maintenance costs. On the other hand, care should be taken not to invest in expensive features which are not required.

A service entrance of at least 60 amps. will be required. Care should be taken to insure adequate circuits and conveniently located outlets for the equipment you will eventually install. All convenience outlets in the shop must be grounded for use with polarized plugs.

Plenty of well planned lighting should be installed for safe and convenient use of the shop facilities.

TYPE OF ELECTRICITY

Saskatchewan farms are supplied with single phase 110-220 volt, 60 cycle electric power. The standard service provides for a maximum motor size of three horsepower. A larger service is required for 5 and 7½ horsepower motors.

Main power lines are 3-phase and farms adjacent can obtain a special 3-phase installation whereby the less

expensive 3-phase motor can be used. Phase converters are now available for adapting single phase current to three phase use. This makes possible the use of a wider variety of electric motors.

SELECTION OF MOTORS

There are three main types of motors —split phase, capacitator and repulsion induction. They differ in their cost and load-starting ability. Split phase motors are the least costly and are available only in sizes up to ½ horsepower. They are only suited to easily started loads such as emery wheels, fanning mills, washing machines, etc. Capacitor type motors are adapted to work requiring medium starting torque—as water pumps, refrigerators, cream separators, etc. Repulsion-induction motors are the most expensive and are adapted to starting under heavy loads such as grain grinder units.

Special types of motors and installations are required for damp or dusty locations. An electrician or your power supplier should be consulted when an installation of this type is to be made.

In selecting an electric motor as a replacement for a gasoline engine, a smaller horsepower rating will suffice. A 1-horsepower electric motor will normally operate a piece of equipment requiring a 2-horsepower gasoline engine.

Electric motors give long periods of trouble-free service if they are not overloaded and are lubricated according to manufacturer's instructions.

OVERLOAD PROTECTION

Many small motors are now being manufactured with built-in overload protection. Overload protection switches may be purchased separately and should be properly sized to the individual motor they are to serve.

The Electrical Code states that all automatically started and stopped motors over ⅓ horsepower and all motors over 1-horsepower must be thermally protected. (It is recommended that manually started motors of ½ to ¾ horsepower also be protected.) Thermal switches with a magnetic trip-out providing addition protection from short circuits are also available.

FARM BUILDINGS

Making Quality Concrete.—Most farm made concrete is of inferior quality. The ratio of water to cement controls the strength of concrete. Approximately 5 gallons of water should be used with each sack of cement and sufficient sand and gravel added to make a workable, but not sloppy mix. More water and sand result in correspondingly weaker concrete. Sand and gravel must be clean, sound and well graded. Most pit run material contains a high proportion of sand, requiring a larger amount of cement. Addition of coarse material will result in economy. Large stones should be less than one third the thickness of the slab or wall. Concrete should be mixed for at least one minute after all materials have been added; otherwise weak spots and leakage can be expected. Concrete should be kept damp and free from frost for at least seven days after placing in order to gain reasonable strength. Calcium chloride in concrete should not be regarded as an antifreeze but may be used in a proportion of not more than two pounds per sack of cement to hasten curing. In alkali soils concrete should be waterproofed or made with sulphate resistant cement.

Foundations.—The primary function of a foundation is to support the weight of the building without serious settlement or heaving. The size of foundation should therefore be designed in accordance with the load to be carried. Masonry buildings are more susceptible to damage by settling. Conventional foundations with footings at least 16 inches in width are common. For light buildings and favorable soil conditions the footing may be omitted and a combined floor slab and foundation provided. In this method of construction the floor slab is thickened to approximately 16 inches under outside walls and bearing partitions. Reinforcing with light rods or wire mesh is recommended. For curved rafter and rigid frame type buildings the foundation should be designed to carry outward thrust. Where pole construction is used the poles serve as the foundation. Concrete placed in the bottom of the post hole increases the load-carrying capacity. Post-pier foundations consisting of 6 inch pressure treated posts set 4 to 5 feet apart and capped with a box sill of treated plank or plywood should be considered. This construction is somewhat lower in cost and requires considerably less labor than other types of foundations. It can be insulated readily for heated animal buildings.

Floors.—Concrete floors are suitable for all types of farm buildings. When used in grain storage 6 mil plastic film or an asphalt layer should be provided underneath to prevent the rise of moisture. Sleeping platforms and brooder

floors in hog buildings can be made warmer by providing a 1 to 4 mix of cement and vermiculite 3 inches thick topped with a 2 inch layer of sand concrete. Waterproofing above and below the vermiculite concrete is recommended.

Wood floors supported above ground level are preferred for grain storage but are more expensive than concrete. Wood floors in livestock buildings present a disease control problem.

METHODS OF FRAMING

Light Timber Framing.—Light timber framing, commonly consisting of studs and rafters at 16 to 24 inch spacing requires angle brancing to prevent distortion due to wind and other loads. Sheathing applied diagonally is most effective, with sheet materials such as plywood ranking second. Braces of two inch material cut to fit between studs are relatively ineffective, but continuous braces of one inch material let into notches in the face of studs are relatively good.

Pole Frame construction uses pressure treated poles at 12 to 15 foot spacing as the basic structural element. Rafters or roof trusses are supported by planks spiked or bolted to the tops of the poles. Wall sheathing is attached to nailing girths placed horizontally. Knee braces and corner braces provide stiffness. Since no stud space is available for filling with insulation, this type of construction is best suited to buildings such as garages, machine sheds and beef cattle shelters.

Roof Trusses can be used to advantage where post free spans greater than 20 feet are desired. Strong joints between members are required. Double splice plates and three inch nails may be used at main connections. 10 to 15 nails in each of the rafter and ceiling joists are required.

Curved Rafters.—Rafters for curved roofs may be sawn to shape or bent to shape. Bent rafters usually consist of several plies of 1 by 3 or 1 by 4 bent to the desired shape in a form and fastened together with nails, bolts, glue or by a combination of these means. The use of glue is strongly recommended. Casein glue is simple to use and satisfactory if not exposed to excessive moisture. Six ply of 1 by 3 is recommended for a building 36 feet wide with rafters at two foot spacing. Sawn rafters are made in a variety of ways, but, in most cases, only one out of two or two out of three ply are effective at the joints. If splice plates of one inch material or plywood are used over the joints, rafters can be of two ply material at two foot spacing.

The Gambrel Roof is now seldom used on barns but provides economical construction for machine sheds and grain storages. Joints between rafters must be well made and attachment to foundations should be secure.

Rigid Frame buildings are similar to curved rafter buildings in shape and in application but have the advantage of using standard size material. Available plans (see references) are rather conservative for the small snow loads experienced in most of Saskatchewan.

Circular Plywood construction is economical for large grain storages. Vertical joints between sheets must be very well made, using glue and nails. Waterproof glue should be used unless protection from moisture is assured.

Roofing.—The following table presents characteristics of some common types of roofing materials.

E: excellent, G: good, F: fair, P: poor.

Material	Initial Cost*	Ease of Application	Probable Life	Relative Upkeep	Decking Required	Minimum Recommended Slope in/ft.
Wood shingles	Moderate	F	G	F	Slatted	6
Asphalt shingles	Moderate to low	G	F	G	Solid	4
Asphalt Roll— 6" lap	Low	G	F	F	Solid	3
—18" lap	Moderate	F	F	G	Solid	1
Built-up	Moderate	P	G	F	Solid	½
Galvanized†	Moderate	G	G	E	2" material, 24" OC	3
Aluminum†	Moderate	G	F	G	2" material, 16" OC	3
Asbestos cement	High	F	E	E	Solid	6
Plywood	Low	G	F	P	None	2

* A range of qualities and prices is available in most types of roofing.
† Flat metal sheets are not recommended.

Insulation.—The following table indicates the properties of a number of types of insulation.
E: excellent, G: good, F: fair, P: poor.

	Mineral Wool	Vermiculite	Paper Fibre	Shavings	Chopped Straw
Resistance to heat flow per inch thickness	E	F	G	F	F
Cost of material	Moderate	High	Moderate	Low	Low
Cost of installing	Moderate	Low	Moderate	Low	Low
Resistance to settling*	Batts G Loose F	E	G unless wet	F	F
Resistance to rot	E	E†	F to G	P	P
Resistance to Fire	E	E	G	P	P
Resistance to insect and rodent attack	E	E	G	F	P

* The tendency of blown-in insulation to settle depends primarily on the operator of the blowing machine.
† Although vermiculite itself will not rot, its tendency to absorb and hold moisture may cause rotting of adjacent wood.

Wood or straw fibreboard has good resistance to heat flow per inch of thickness but thicknesses available are one inch and less. For some applications 4 or more inches of insulation is required.

Condensation.—When warm moist air comes in contact with a cold surface, some of the moisture condenses, either as liquid or as frost depending on the temperature of the surface. Condensation can be controlled by making the surface warmer (insulating) or by reducing the relative humidity of the air (ventilating) or by preventing the moist air from coming in contact with the cold surface (vapor proofing). Insulating makes the warm side warmer but the cold side colder and more likely to collect frost. A vapor barrier should be provided on the warm side of the insulation to prevent water vapor reaching the cold side. The vapor barrier may consist of plastic film. suitable paper or suitable paint films. Condensation problems can also be minimized by using outside coverings that will allow moisture to escape.

Ventilation of livestock buildings in winter is needed primarily to remove moisture given off by the animals. The insulation of walls and ceilings and the provision of storm windows and doors is necessary to reduce heat loss so as to allow moisture to be removed by ventilation without excessively reducing inside temperature. In sub-zero weather it may not be possible to keep the building both warm and dry if animals are the only source of heat.

Ventilation with electrically driven fans is fairly common and is generally satisfactory where a fan of correct size is used. A fan that is too large will only run for short periods. Fans for ventilation of livestock buildings should be of corrosion resistant material, should have totally enclosed motors and should be controlled by rugged thermostats. Flues or ducts through the roof move air due to chimney action or wind forces so there is considerable variation in the amount of ventilation. In so far as is possible, flues should be straight, smooth and warmly built. A damper or slide valve should be provided to restrict air flow in cold weather. The following table shows the number of animal units which can be served by flues of various sizes. One animal unit is equivalent to one 1000 pound cow, six pigs weighing 120 pounds each or twenty-five chickens weighing 4 pounds each.

Number of Animal Units Served by Flues of Various Sizes and Height

Flue Size	Flue Height above ceiling		
	10	15	25
	Animal Units		
12 x 12	2	3	4
16 x 16	5	6	7
24 x 24	12	14	17
24 x 30	18	21	28

Fans should be capable of delivering 50 cubic feet of air per minute for each animal unit. Inlets for fresh air may be necessary to ensure circulation in all parts of the building. Fresh air should enter near the ceiling and be directed up to reduce drafts on animals.

COST OF HEATING

Fuel	Cost per unit	Efficiency Assumed	Cost per million Btu of heat received
Drumheller coal	$15 per ton	50%	$1.60
Estevan coal	$8 per ton	45%	$1.27
Oil	18c per gal.	Pot type burner 50%	$2.15
		Gun type burner 60%	$1.80
Liquefied propane gas	$9 per bottle	70%	$6.40
	20c per gal.	70%	$2.60
Natural Gas	65c per M cu. ft.	70%	$0.95
	80c per M cu. ft.	70%	$1.15
Electricity	2c per kwh.	100%	$5.85

Note: Local fuel prices will vary from the above, so should be checked before using this table.

Water Supply.—If possible, the farm water supply should be adequate and of good quality. Tests for chemical composition and suitability for drinking are performed free of charge by the Department of Public Health in Regina. Write for instructions and a standard container. Hard water may be softened in most cases by the addition of chemicals or by the use of a Zeolite softener.

Pumps for farm water supply are available in a wide range of sizes and types. The depth to water and the location of the dugout or well with respect to the buildings are important factors in the selection of type of pump as also are the quantity of water required per day and the rate of flow into the well. Where the suction lift, including friction losses in the piping, is less than 20 feet, a shallow well pump of the centrifugal jet or reciprocating type is usually satisfactory. For depths in excess of 200 feet, the conventional rod and cylinder or the submersible type of pump will have to be used. For intermediate depths the jet pump may be used.

Sewage Disposal. — Where a flush toilet will be used, a septic tank is required to separate liquids from solids and allow the solids to decay. All waste water should pass through the septic tank with the exception of that which contains a considerable quantity of strong chemicals or salts. Septic tanks are best made of concrete and should have a minimum capacity of 400 gallons. Liquid from the septic tank may be disposed of in one of three ways. It can flow into a cistern which is pumped out into the ground surface as required. A disposal field consisting of open jointed tile or perforated pipe may be used. An above-ground filter of gravel into which the liquid can be pumped in 50 gallon lots is also common. The best system for a particular case will depend on the type of soil and the possibility of contaminating the water supply.

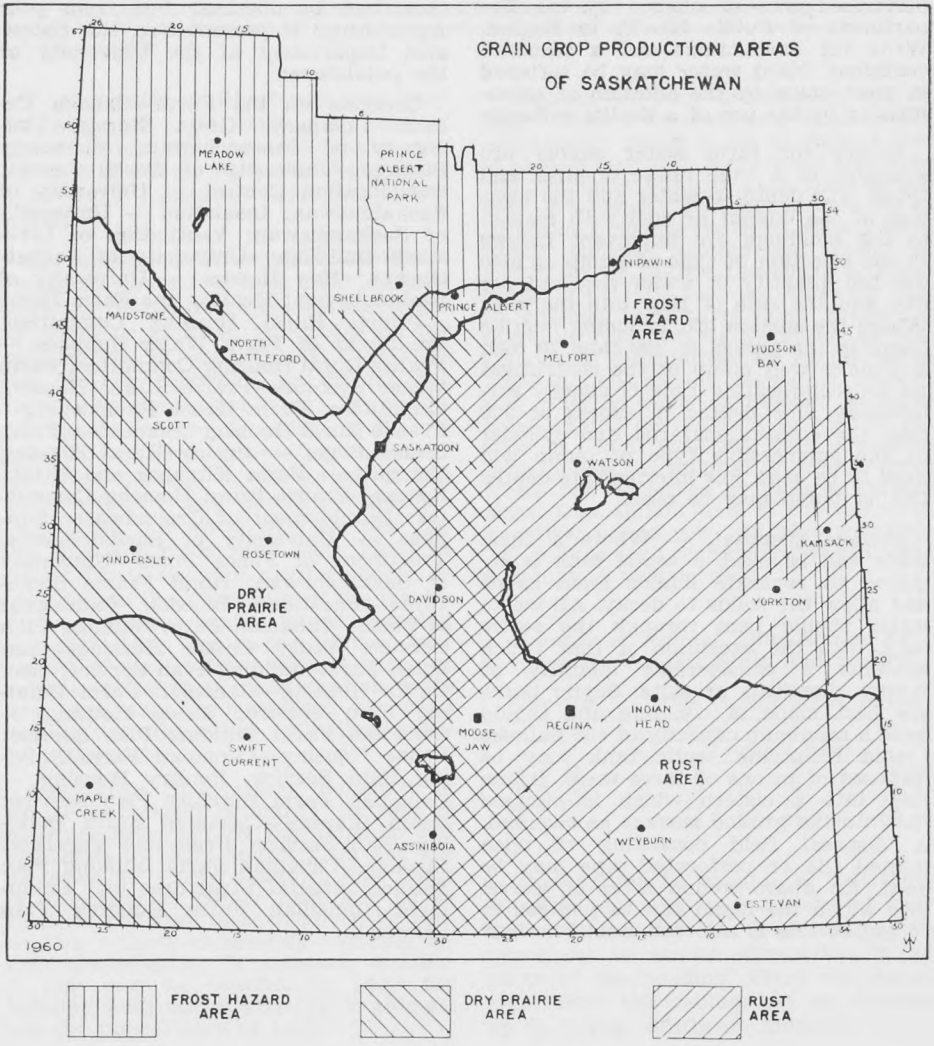
References. — The following publications can be obtained free from your Agricultural Representative, the Extension Department at the University or the publishers:

Concrete on the Farm—Canada Cement Company; Grain Storage—University of Saskatchewan; Machinery Storage—University of Saskatchewan; Condensation Control — University of Saskatchewan; Insulation — University of Saskatchewan; Ventilation of Livestock Buildings—University of Saskatchewan; Hog Houses — University of Saskatchewan; Heating the Farm Home —Prairie Rural Housing Committee; Treatment of Farm Water Supplies — Prairie Rural Housing Committee; Farm Water Systems—Prairie Rural Housing Committee; Farm House Remodelling—Prairie Rural Housing Committee; Farm House Plans — Prairie Rural Housing Committee; Farm Kitchens and Utility Rooms—Prairie Rural Housing Committee; Development of Groundwater Supplies — University of Saskatchewan; Treatment of Fence Posts—University of Saskatchewan; Rigid Frame Structures—MacMillan Bloedel; Catalogues of plans—Canadian Farm Building Plan Service; Dairy Cattle Housing—Canadian Farm Building Plan Service; Beef Cattle Housing—Canadian Farm Building Plan Service; Sheep Housing — Canadian Farm Building Plan Service; Swine Housing—Canadian Farm Building Plan Service; Poultry Housing — Canadian Farm Building Plan Service; Grain Storage—Canadian Farm Building Plan Service; Fruit and Vegetable Storage—Canadian Farm Building Plan Service; Special Structures and Equipment—Canadian Farm Building Plan Service.

GRAIN CROP VARIETIES

Saskatchewan is Canada's leading grain growing province. During the period 1956 to 1958 the average acreage and production of the major grain crops in Saskatchewan, expressed as a percentage of Canadian totals, was as follows (% production figures in brackets): wheat 65% (60%), oats 29% (24%), barley 39% (37%), rye 50% (38%), flax 57% (53%). There are about 22 million acres seeded annually to these five grain crops in the province.

For all grain crops the growing of recommended varieties is of great importance. The ravages of certain diseases and insect pests can be reduced or eliminated by using the proper variety. A large portion of the wheat produced in the province is exported. In the export market high milling and baking quality is of primary importance. Hence it is imperative that only varieties possessing acceptable quality be grown and only such varieties are recommended. Licensed varieties which are not recommended for use in the province are usually less suitable in one or more respects than the recommended varieties.



GRAIN CROP PRODUCTION AREAS

Yielding ability, straw strength, shattering resistance, and disease, insect, and climatic hazards are the main factors used in making variety recommendations. On the basis of hazards the province can be broadly divided into three areas; namely, the rust area, the dry prairie area, and the frost area. These areas are shown on the accompanying map. The boundaries of the areas are neither sharply defined nor constant from year to year and may overlap to some extent.

Rust Area:—This area is subject to infections of leaf and stem rust of wheat, and rusts of barley and oats. The hazard of such infections is greatest in the southern and eastern sections of the area.

Dry Prairie Area:—The hazard of drought prevails for all crops grown in this area. Wheat stem sawfly is a continual threat to wheat production over a considerable portion of the area and particularly in the southwest.

Frost Hazard Area:—In this area the frost-free period tends to be shorter than it is further south. Disease, insect, or drought hazards may exist along with the frost hazard.

Park Belt Area:—This area is not marked on the accompanying map. It embraces the black, greyish black and grey soil zones (see soil zone map page 11). Climatically it is characterized by higher available moisture supply, lower evaporation rates, lower wind velocity and lower average temperatures than generally prevail elsewhere in the crop-growing area of the province.

WHEAT

RECOMMENDED VARIETIES

Listed alphabetically (not in order of preference)

Rust Area:

Bread Wheat—Pembina and Selkirk.
Durum Wheat—Ramsey.

Dry Prairie Area:

Bread Wheat—Chinook and Rescue, where sawfly is a problem.
Canthatch and Thatcher, where sawfly is not a problem.
Lake, for the northwestern part of the area.
Durum Wheat—Ramsey and Stewart.

Frost Hazard Area:

Bread Wheat—Canthatch, Selkirk, Thatcher.
Lake, high yielding but somewhat late.
Durum Wheat—not recommended.

DESCRIPTION OF WHEAT VARIETIES

BREAD WHEAT

Thatcher is one of the best varieties of bread wheat for milling and baking and is still the most widely adapted variety in Saskatchewan. It has short, strong straw, is resistant to shattering, and is, therefore, the best variety for straight combining. In addition, it is resistant to spring frost and is early in maturity. The kernels are small and tend to bleach when exposed to weathering. Thatcher is susceptible to race 15B of stem rust and to leaf rust.

Canthatch is very similar to Thatcher except that it has resistance to race 15B of stem rust. Like Thatcher it is very susceptible to leaf rust. Canthatch may be used to replace Thatcher but it **should not** be grown as a substitute for Selkirk in the rust area.

Lake has done particularly well in the western and northern portions of the dry prairie and frost hazard areas, although it is usually two or three days later than Thatcher. It is taller than Thatcher but normally stands well. However, it may tend to shatter at maturity. The kernels are larger but bushel weight is less than Thatcher and it may grade lower. It is susceptible to leaf rust and to race 15B of stem rust.

Selkirk has satisfactory resistance to both leaf rust and race 15B of stem rust. It has short, strong straw, however, it may shatter at maturity if left for straight combining. It matures about the same time as Thatcher. It has larger kernels than Thatcher but has low bushel weight.

Pembina is better than Selkirk in resistance to both leaf and stem rust and provides an alternate variety where rust is a serious threat. Its milling and baking qualities are superior to those of Selkirk. Pembina is a day or so earlier than Thatcher and is about equal in strength of straw. The kernels are slightly larger than those of Thatcher.

Rescue is the most sawfly resistant variety of bread wheat. It is not equal to

the standard, Marquis, in milling and baking quality. For this reason it is recommended only where resistance to sawfly is needed. Compared with Thatcher, Rescue has slightly taller, weaker straw, is a day or so later and shatters more easily. It has larger kernels and higher bushel weight. Rescue is susceptible to spring frost damage, leaf rust and race 15B of stem rust.

Chinook is a sawfly resistant variety which has good milling and baking quality and high bushel weight. It tends to be a little less sawfly resistant than Rescue. It is similar to Rescue in height, strength of straw and susceptibility to shattering. Like Rescue it is susceptible to spring frost, leaf rust and race 15B of stem rust.

DURUM WHEAT

Durum or macaroni wheats have proven valuable in the sawfly area because of their moderate resistance to this pest. They are often a week or more later in maturing than bread wheats and have much taller, weaker straw. For this reason they are not recommended in the northern areas. In general they are more susceptible to root rots than the bread wheats. In areas where they are recommended they usually yield as much as or more than the bread wheats.

Stewart is of good quality and is eligible for the top grades. It is late and has tall, moderately strong straw. Stewart is very susceptible to race 15B of stem rust but is resistant to leaf rust.

Ramsey is resistant both to race 15B of stem rust and to leaf rust. It has good quality and is eligible for the top grades. Like Stewart it is late but is somewhat shorter and has stronger straw.

WINTER WHEAT

While winter wheat is not recommended for general use in Saskatchewan, it is being grown more or less satisfactorily in the extreme southwest corner of the province and with only occasional success in some northern areas where snow cover may be heavy. Winter wheat, where it winters successfully, may excel spring wheat in yield and has the advantage of distributing harvesting over a longer period. There may be some difficulty in marketing this crop, because of the danger of mixing with spring wheat. Breeding and testing work on this crop is under way.

OATS

Where droughty conditions frequently occur, it is recommended that oats be sown early on summerfallow

RECOMMENDED VARIETIES

Listed alphabetically (not in order of preference)

Rust Area:

Garry and Rodney should have preference.

Ajax may be used where early maturity is desired.

Dry Prairie Area:

Ajax, Eagle, Exeter, Fortune, Garry, Rodney.

Frost Hazard Area:

Eagle, Exeter, Garry, Rodney.

Also for the Meadow Lake district, Fortune and Victory.

Special Purposes:

Larain may be used when late seeding is necessary.

Torch and Vicar are hulless varieties.

DESCRIPTION OF OAT VARIETIES

Garry is a medium maturing variety with wide adaptation. The straw is mid-tall and resistant to lodging. Garry is resistant to the smuts, stem rust and most races of crown (leaf) rust.

Rodney is later maturing than Garry but similar in length of straw and lodging resistance. It has large plump kernels which peel easily. Rodney is resistant to the smuts and most races of stem and crown (leaf) rust.

Exeter is a mid-tall variety that has a tendency to lodge. It matures later than Garry. Exeter is susecptible to the smuts, crown (leaf) rust, and some races of stem rust.

Eagle is a late maturing variety that is more likely to lodge than Garry. It is susceptible to the rusts and smuts.

Ajax is an early maturing variety with rather small kernels. It is mid-tall and has a tendency to lodge. Ajax is susceptible to the smuts, crown (leaf) rust and some races of stem rust.

Fortune is similar in maturity but more susceptible to lodging than Garry. It is resistant to the smuts but susceptible to crown (leaf) rust and some races of stem rust.

Victory is late maturing, mid-tall, and has a tendency to lodge. It is susceptible to the rusts and smuts.

Larain is an early maturing oat that may be used for late seeding. It is reasonably resistant to lodging but is low yielding compared with the later maturing varieties. It is susceptible to the rusts and smuts.

Torch and **Vicar** are medium late, hulless varieties resistant to the smuts and also to the prevailing races of stem rust.

BARLEY

Barley usually produces more feed units per acre than either wheat or oats. It has generally given better results when sown early on summerfallow, particularly on the dry open plains. Depending upon the variety, three classes of barley are recognized: feed (non-malting), malting and pearling (eligible for C.W. Grades).

RECOMMENDED VARIETIES

Listed alphabetically (not in order of preference)

Rust Area:

Feed Varieties

Husky, Vantage, Vantmore.

Varieties eligible for C.W. Grades

Hannchen, Montcalm, Parkland.

Dry Prairie Area:

Feed Varieties

Husky, Vantage.

Varieties eligible for C.W. Grades

Compana.

Hannchen, Montcalm and Parkland are generally lower yielding than feed varieties in this area.

Frost Hazard Area:

Feed Varieties

Husky.

Varieties eligible for C.W. Grades

Hannchen, Montcalm, Parkland.

DESCRIPTION OF BARLEY VARIETIES

Six-Rowed Smooth Awned Feed Varieties

Vantage is a medium late, medium strong-strawed barley. It is resistant to stem rust but susceptible to leaf rust and both loose and covered smuts. Frequently the awns are difficult to remove in threshing.

Husky is a high yielding, moderately strong-strawed barley. It tends to be a few days later in maturity than Vantage and has a tendency to shatter. It is not recommended for straight combing. Husky is resistant to stem rust, moderately susceptible to leaf rust and covered smut, and is susceptible to true loose smut.

Vantmore is very similar to Vantage in most characteristics; however, it has more resistance to some leaf diseases.

Six-Rowed Smooth Awned Malting Varieties

Montcalm is a blue seeded variety eligible for the highest malting grades. Compared with Vantage, it is slightly earlier in maturity but has considerably weaker straw. It is susceptible to stem and leaf rust and to loose smut, but moderately resistant to covered smut.

Parkland is a rust resistant blue seeded variety eligible for the highest malting grades. Compared with Montcalm, it is equal in maturity but has stronger straw. It is moderately susceptible to the smuts.

Two-Rowed Varieties

Hannchen is a rough awned variety eligible for the highest two-row grades. Compared with Vantage, it is equal in maturity and has weaker straw, nevertheless it is reasonably satisfactory for straight combining. It is susceptible to both rusts and smuts. Because of the good quality and light colour of the seed, Hannchen is popular as a pearling barley.

Compana is a smooth awned barley which is eligible for the No. 3 C.W. Two-Row grade. Compared with Hannchen, it is earlier in maturity and has shorter straw. It is reasonably satisfactory for straight combining. It is susceptible to both rusts and smuts.

Varieties Recommended for Special Purposes

Olli, Titan and Warrior are six-rowed, early maturing varieties suitable for delayed seeding for wild oat control outside the rust area.

Olli is a rough-awned variety, eligible for the C.W. Grades but has weak straw. It is susceptible to the smuts and rusts and is generally lower in yield than the recommended varieties.

Titan and Warrior are eligible for Feed Grades only. Compared with Olli, they both have stronger straw. Warrior is a hooded (awnless) variety with a low bushel weight and is susceptible to the smuts and rusts.

RYE

Rye, particularly fall rye, is very useful on the lighter textured, droughty soils and is useful in annual weed and soil erosion control.

RECOMMENDED VARIETIES

Listed alphabetically (not in order of preference).

Fall Rye—Antelope, Dakold 23.

Spring Rye—Prolific.

DESCRIPTION OF RECOMMENDED VARIETIES

Dakold 23 (fall rye) is generally winter hardy, has fine straw and medium to small kernels of variable color.

Antelope (fall rye) is generally winter hardy, has fine straw and medium-sized kernels of variable color.

Prolific (spring rye) has medium straw, medium large kernels of a fairly uniform gray-blue color.

DESCRIPTION OF VARIETIES NOT RECOMMENDED

All of the following varieies are high yielding if there is no winter-killing.

Dominant (fall rye) is not as winter hardy as Dakold 23. It has medium straw and medium large kernels of a uniform gray-blue color.

Petkus (fall rye) is not as winter hardy as Dakold 23. It has medium to thick straw and medium to large kernels of a uniform gray-blue color.

Sangaste (fall rye) is not as winter hardy as Dakold 23. It has medium to thick straw and medium to large kernels of a uniform tan color.

Tetra Petkus (fall rye) is not winter hardy in Saskatchewan. It has thick straw and large kernels of a uniform gray-blue color.

FLAX

To control seed-borne diseases, it is always advisable to treat flax seed with a recommended fungicide containing either mercury or captan. Fungicides should be applied at least 24 hours before seeding, except when otherwise specified by the manufacturer, and at recommended rates. In addition, as most flax diseases over winter on the straw, flax should not follow flax. All recommended varieties are susceptible to pasmo and aster yellows.

RECOMMENDED VARIETIES

Listed alphabetically (not in order of preference)

Normally a late maturing variety of flax will outyield an early maturing variety. However, an early maturing variety is recommended when late seeding is necessary, and in the northern areas, because of the frost hazard.

Rust Area:

Norland, Redwood, Rocket. Where an early variety is needed use Marine.

Dry Prairie Area:

Norland, Redwood, Rocket.

Frost Hazard Area:

Norland, Redwood, Rocket. Where an early variety is needed use Marine or Raja. Redwing may be used in the northwest corner of the province.

DESCRIPTION OF VARIETIES

Marine is resistant to wilt and rust and moderately tolerant to pasmo. Since it matures about a week earlier than Redwood it is useful for late seeding. It is similar to Redwood in flower color but has smaller seeds and a lower oil content.

Norland is resistant to wilt and rust. It has white blossoms, large seeds and is high in oil content and quality. It is equal to Redwood in maturity.

Raja matures about a week earlier than Redwood and is therefore useful for late seeding. It is rust and wilt resistant and has larger seeds and a lower oil content than Redwood. Raja is a blue-flowered variety that is sometimes short and low in yield, particularly when sown early.

Redwood is a blue-flowered variety

which is resistant to wilt and rust. It is medium late and is high in oil content and quality.

Redwing is a small seeded, blue flowered variety which is resistant to wilt and susceptible to rust. It is lower in yield and oil content than Redwood, but as it matures about a week earlier, it is useful where early maturity is essential and flax rust is not a problem.

Rocket is a blue-flowered, large seeded variety which is resistant to wilt and rust. It is medium late and is high in oil content and quality.

RAPE

Rape is adapted particularly to the Park belt area of the province. In the dry prairie area it tends to suffer from drought.

RECOMMENDED VARIETIES

Listed alphabetically (not in order of preference)

Argentine Type—Argentine, Golden.
Polish Type—Arlo, Polish.

COMMENTS ON TYPES AND VARIETIES

ARGENTINE TYPE: Varieties of this type are fairly tall growing and require about the same growing time as wheat. Seedlings of the Argentine type are more susceptible to spring frost damage than seedlings of the Polish type.

Seed of Golden has a higher oil content than seed of Argentine. Otherwise these two varieties are quite similar. Registered and Certified seed of only the Golden variety is obtainable.

POLISH TYPE: Varieties of this type are shorter, have smaller seeds, and mature about three weeks earlier than varieties of the Argentine type. Seedlings are fairly frost resistant. Varieties of this type are recommended where the frost-free season tends to be short or where seeding is delayed until late May or early June.

Arlo is quite similar to Polish but the seed has a higher oil content. Registered and Certified seed of only the Arlo variety is obtainable.

SEED FACTS

SEED GRAIN

The importance of producing high quality crops cannot be over-emphasized. Only good seed of recommended varieties should be planted. Good seed has high germination and is sound, thus ensuring vigorous, uniform seedling growth. It is practically free from disease, weed seeds and admixtures of other varieties and crops.

Samples of any grain intended for seeding purposes should be tested for germination. Local elevator agents will accept samples for testing. However, for official germination tests, samples must be sent to Plant Products Division, 413 London Building, Saskatoon together with a prepaid fee of 75 cents for each sample.

Registered and Certified seeds are the best seeds to buy. They assure purity as to variety, have good germination, are practically free from disease, weed seeds and other crop kinds. Purchases of these classes of seed are a worthwhile investment.

Information on sources and prices of Registered and Certified seeds is available from local elevator agents who are authorized to accept orders for seed. Seed also is available directly from seed dealers and seed growers. You may contact your Agricultural Representative, the Field Husbandry Department, University of Saskatchewan, the Experimental Farms or the Plant Industry Branch, Saskatchewan Department of Agriculture, about information on good seed.

SEED CLEANING

Only clean grain should be sown. The best procedure is to use home cleaning units or central cleaning plants specializing in these operations. Most commercial grain elevators are not equipped to clean grain for seed purposes. The practice of cleaning grain for seed at these elevators should be discouraged because it tends to spread weed seeds and diseases, and may result in admixtures of other varieties and crop kinds.

SEED TREATMENT

For information on seed treatments for the control of surface-borne smuts, seed rot and seedling blights of cereals see section "Treatment for Smuts Carried on the Seed and Pointers Concerning Seed Treatment," page 96. Information on seed dressings for wireworm control may be found in the section on Wireworms on page 109.

* * *

If in doubt about non-recommended varieties consult your nearest Federal Experimental Farm, Agricultural Representative, or the University of Saskatchewan.

FORAGE CROPS

The rigorous climate of Saskatchewan limits the number of grasses and legumes that can be grown successfully. Winter hardiness throughout the Province and drought tolerance in the plains area are essential. Only a few hay and pasture crops meet these exacting requirements.

Census data from 1921 to 1951 show a steady increase in the acreage of forage crops from approximately 1 per cent of the total cultivated acreage to slightly over 5 per cent. The need for more forage crops is recognized by both Federal and Provincial Departments of Agriculture. The Federal Department sponsors the Canadian Forage Seeds Project which multiplies seed supplies of recommended varieties. The Saskatchewan Department operates a forage crop program to supply seed of recommended grasses, legumes and mixtures to farmers at wholesale prices. From 1947 to 1960, 50,000 farmers ordered seed for 1,000,000 acres under the program.

CULTIVATED FORAGE CROPS

PERENNIAL GRASSES

(See Tables 1, 2, and 3 for recommended mixtures and rates of seeding)

Crested Wheatgrass. — Recommended varieties are Fairway, Summit, and Nordan. Crested wheatgrass is a very winter hardy bunch grass that stands long drought periods. Flooding for more than one week may cause severe damage. It is good for spring pasture and makes good hay if cut shortly after heading. The Fairway variety is used for unwatered lawns and turf in the Brown and Dark Brown Soil Zones. Hay yields of Summit and Nordan are 10 per cent above those of Fairway. Summit and Nordan are also more suitable than Fairway in mixtures with alfalfa. All varieties appear equally useful for pasture. In northern areas Fairway persists longer than Summit or Nordan. Seed yields of Nordan are approximately 10 per cent above those of Fairway, and seed yields of Summit are 10 per cent below those of Fairway.

Bromegrass is long-lived and fairly drought resistant, with an extensive creeping root system. It withstands up to 3 weeks of flooding in the spring. It is leafy and quite tall. It is a good pasture and hay crop in all but the driest districts of the Province. Brome is the most important forage grass in Western Canada with particular adaptation in the Black Soil Zone.

Almost all bromegrass in Western Canada is of the northern commercial type with no varietal name. Saratoga, Lincoln, Fischer, and Achenbach are varieties of the southern type developed in the states of New York, Nebraska, Iowa, and Kansas respectively. Forage yields of these varieties are equivalent to those of northern bromegrass but in northern areas of the Province they lack persistence. Seed yields of southern varieties are 20-30 per cent below those of northern commercial. These varieties should be considered primarily as varieties for export seed production. Manchar bromegrass of the northern type was developed in Washington State and is recommended in the Pacific Northwest and parts of British Columbia. It has no advantage over the northern commercial type in Saskatchewan.

Slender Wheatgrass.—Primar is the recommended variety. Slender wheatgrass is a short-lived (about 3 years), fairly drought resistant bunch grass. It withstands up to 4 weeks of flooding in the spring and is quite tolerant of salinity. It is a good hay crop for use in short rotations. It is susceptible to wheat stem sawfly attack.

Intermediate Wheatgrass is a fairly long-lived, tall-growing grass with creeping rootstocks. With alfalfa it makes excellent hay or pasture, often outyielding other grass-alfalfa mixtures. The seedlings are vigorous and because of this a stand is quickly established. Winter-killing often occurs in this grass, especially following dry seasons. It survives up to 2 weeks of flooding in the spring. It is generally adapted wherever bromegrass does well.

Tall Wheatgrass is a special purpose grass for saline areas. It is a fairly long-lived bunch grass but has little drought resistance. It withstands up to 5 weeks of spring flooding. It grows very tall under moist conditions and the stems and leaves are quite coarse. It heads late in July and should be harvested for hay when heading begins. As hay it is slightly lower in feeding value than brome or crested wheat. It

makes fair summer pasturage but lacks palatability, particularly if growth gets tall.

Russian Wild Ryegrass is a long-lived, very drought-resistant bunch grass with an extensive, tough root system. It produces mostly basal leaves and is a valuable pasture grass. It is not recommended for hay production. It is very palatable as pasture the year round and cures well in the fall. It excels all grasses as a late summer and fall pasture. Its protein content in August and September may be twice as high as that of crested wheatgrass. Russian wild rye does not become established as rapidly as other grasses nor does it withstand the competition of companion crops. Spring seeding is preferable to fall seeding.

Timothy.—The variety Climax is recommended. It is a fairly short-lived bunch grass that lacks drought resistance. It is tall and leafy and readily eaten by livestock. It withstands up to 5 weeks of spring flooding and is a useful hay and pasture crop in mixtures on wet meadows.

Creeping Red Fescue is fairly long-lived and has creeping roots that form a dense sod. Since the leaves are mostly basal it is used mainly for pasture and lawn purposes. It is not drought resistant and does best in the Black and Grey Soil Zones.

Reed Canary Grass is long-lived and has coarse creeping roots. The crop grows tall and is leafy. The forage tends to be coarse and is only moderately palatable. It withstands long periods of flooding (2 months and more in shallow water). It is adapted to slough conditions and does well under irrigation where it persists better than most grasses. It lacks hardiness on dry upland soils. The Frontier variety should be considered for seed production.

Streambank Wheatgrass.—The Sodar variety is recommended. It is a long-lived, drought-resistant grass. It has a strong creeping root system which forms a dense sod. This is a special purpose grass recommended for seeding down ditch and canal banks, roadsides, machinery yards, etc. It is well adapted to the Brown and Dark Brown Soil Zones.

Sheep Fescue is a long-lived bunch grass with greater drought tolerance and winter hardiness than creeping red fescue. Recent tests indicate this grass to be useful for turf in the Brown and Dark Brown Soil Zones. The grass is finer than Fairway crested wheatgrass, Russian wild ryegrass, or streambank wheatgrass. No varieties are available, but the taller "hard fescue" form appears most desirable.

TABLE 1.—RECOMMENDED FORAGE CROPS FOR WELL-DRAINED UPLAND SOILS

Soil Zone and Row Spacing	Crops	Seeding Rate in Pounds per Acre*	
		for Hay	for Pasture
Brown and Dark Brown Soil Zones 12″ – 18″ row spacings	Crested wheatgrass + alfalfa	4 + 2	4 + 1
	Crested wheatgrass + brome + alfalfa	2 + 4 + 2	2 + 4 + 1
	Crested wheatgrass + intermediate wheatgrass + alfalfa	2 + 6 + 2	2 + 6 + 1
	Russian wild ryegrass + brome + alfalfa	Not recommended	4 + 5 + 1
	Brome + alfalfa	7 + 2	7 + 1
	Intermediate wheatgrass + alfalfa	12 + 2	12 + 1
	Russian wild ryegrass + alfalfa	Not recommended	6 + 1
	Crested wheatgrass	Not recommended	5
	Brome	Not recommended	8
	Intermediate wheatgrass	Not recommended	14
	Russian wild ryegrass	Not recommended	7
	Alfalfa	6	Not recommended
	Sweetclover (seed in 6″ rows)	12	Not recommended
Black and Grey Soil Zones 6″ – 7″ row spacings	Brome + alfalfa	8 + 2	8 + 1
	Intermediate wheatgrass + alfalfa	14 + 2	14 + 1
	Brome + crested wheatgrass + alfalfa	5 + 3 + 2	5 + 3 + 1
	Crested wheatgrass + intermediate wheatgrass + alfalfa	3 + 6 + 2	3 + 6 + 1
	Alfalfa	8	Not recommended
	Sweetclover	15	Not recommended
	Russian wild ryegrass	Not recommended	7

*Summit and other strains of the Standard type should be seeded at 1 ½ times the rate of Fairway.

TABLE 2.—RECOMMENDED FORAGE CROPS FOR POORLY-DRAINED SOILS FOR ALL SOIL ZONES

(6-7 inch row spacing)

Conditions of Spring Flooding and Salinity	Crops	Seeding Rate Pounds per Acre for Hay or Pasture
3-5 weeks flooding; little or no salinity	Reed canary	5
	Reed canary + timothy + slender wheat	3 + 3 + 3
	Timothy + brome + alsike	3 + 6 + 2
	Timothy + brome + slender wheat + alsike	3 + 3 + 3 + 2
Over 6 weeks flooding; little or no salinity	Reed canary	5
	Reed canary + timothy	4 + 3
	Reed canary + timothy + slender wheat	3 + 3 + 3
3-5 weeks flooding; slightly to moderately saline	Tall wheat + slender wheat	10 + 5
	Slender wheat + brome + tall wheat + reed canary	4 + 4 + 4 + 2
Over 6 weeks flooding; slightly to moderately saline	Reed canary + timothy	4 + 3
	Reed canary + timothy + slender wheat	3 + 3 + 3
	Reed canary	5
Poorly drained peaty soils	Timothy + alsike	5 + 2
	Timothy + brome + slender wheat + alsike	3 + 3 + 3 + 2
	Timothy + brome + alsike	3 + 6 + 2
	Reed canary + timothy	4 + 3

TABLE 3.—RECOMMENDED FORAGE CROPS FOR IRRIGATED LAND.

(6-7 inch row spacing)

Crop	Seeding Rate in Pounds per Acre	
	Hay	Pasture
Alfalfa	10	Not recommended
Brome + alfalfa	12 + 3	12 + 3
Intermediate wheat + alfalfa	14 + 3	14 + 3
Reed canary + alfalfa	5 + 3	5 + 3
Intermediate wheat + timothy + creeping red fescue + alfalfa	Not recommended	10 + 3 + 4 + 3
Brome + timothy + creeping red fescue + alfalfa	Not recommended	9 + 3 + 4 + 3

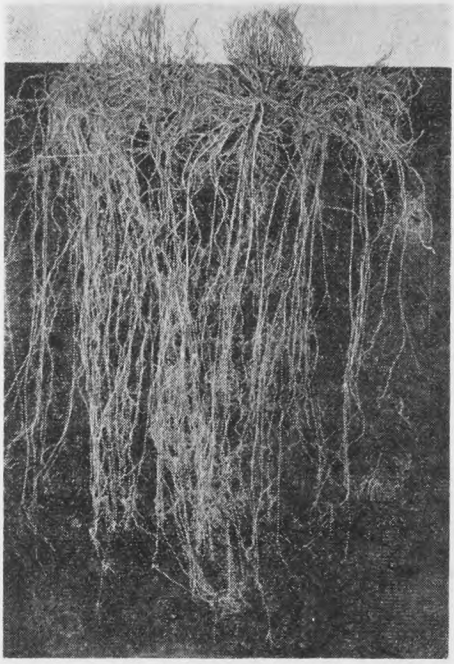
LEGUMES

(See Tables 1, 2, and 3 for recommended mixtures and rates of seeding)

As a group, legumes differ from grasses in that they have the ability to use nitrogen from the air through the action of bacteria which live in nodules on the legume roots. Because they are not dependent on the soil for their nitrogen, legumes yield much more than grasses if a deficiency of soil nitrogen develops. Legume hay generally contains more protein and vitamins than grass hay and thus is especially useful for young or milking animals. Bloat is not a serious hazard in pasturing legumes if the recommended mixtures are used and good management practiced (See page 64 for additional information on bloat). Birdsfoot trefoil, unlike other legumes, does not cause bloat.

Alfalfa.—The recommended varieties are Rambler, Ladak, Vernal, and Grimm. Alfalfa is a long-lived perennial with a deeply penetrating root system. The variety Rambler is creeping-rooted and more drought tolerant and winter hardy than the others. Bacterial wilt is a disease that may be a problem on irrigated land. Vernal is highly resistant, Ladak and Rambler have some resistance, and Grimm is completely susceptible. Rambler shows a great many yellow- and cream-colored flowers; Vernal and Ladak more blue- and purple-colored, and Grimm is almost entirely blue- and purple-flowered.

Sweetclover.—Recommended varieties are Erector, Arctic, Cumino, Alpha, and



Creeping-rooted alfalfa plant. This root system is typical of the Rambler variety. It is winter hardy, drought resistant, and persists under grazing. Rambler is especially recommended for dryland pasture mixtures and gives a heavy yield of hay on the first cutting.

Brandon Dwarf. Sweetclover is a hardy drought-resistant legume living 2 years. It is fairly resistant to saline conditions but will not stand over 1 week of flooding. Sweetclover is one of the highest yielding forage crops but tends to be coarse. It is often used for silage or soil-improvement in the northeastern part of the Province. The sweetclover weevil is the major insect pest of sweetclover in Saskatchewan. Chemical control, however, gives excellent results (see Table 1 of Insect Pest section).

Arctic (white-blossomed) and Erector (yellow-blossomed) are fairly tall-growing varieties that yield exceedingly well throughout the Province. Alpha (white) and Brandon Dwarf (white) are fine-stemmed leafy varieties that are ½ to ⅔ the height of Arctic and Erector and produce 75 per cent of the forage yield of Arctic and Erector. They are well adapted to the northern and eastern part of the Province where taller varieties cause harvesting difficulties. The variety Madrid (yellow) is not recommended as it may winter kill and is inferior as a green manure crop in Saskatchewan.

Cumino (white) is a recent variety bred at Saskatoon. Unlike all other varieties of sweetclover it does not contain coumarin. Coumarin is the compound in ordinary sweetclover that is responsible for "Sweetclover Disease" which may develop when animals eat spoiled sweetclover hay or spoiled silage. It also causes "Melilot Taint" in wheat that is harvested with green plants of sweetclover. Cumino avoids the problem of melilot taint and sweetclover disease. This new variety is considered equal to Arctic and Erector in seed and forage yield but matures 1 week later than Arctic. All varieties of sweetclover including Cumino may cause bloat.

Red Clover.—The recommended varieties are Altaswede and Lasalle. Red Clover is a relatively short-lived perennial. It is not drought resistant and not completely winter hardy. It is grown in northern Saskatchewan primarily for seed production. Altaswede is more winter hardy than Lasalle but the latter is grown as a seed crop since it has a ready market in Eastern Canada.

Alsike Clover is a short-lived perennial which reseeds itself readily. It is not drought resistant and sometimes winter kills. It is the best legume to sow with grasses in wet meadows and peat bogs. Flooding tolerance of established stands in the spring is 14 to 21 days.

Birdsfoot Trefoil.—Recommended varrieties for trial are Empire and Viking. This is the only legume known which does not cause bloat. It is more tolerant of spring flooding than alfalfa and sweetclover but does not yield as well on well-drained upland soils. Birdsfoot trefoil is a good late summer pasture crop as the plants remain green after the seed pods form. The crop is not completely winter hardy and the seed pods shatter readily. For these reasons it should be grown only on a trial basis. The proper seed inoculum for birdsfoot trefoil must be used as it does not occur naturally in Saskatchewan soils.

ANNUAL FORAGE CROPS

Cereals.—Cereal crops are the major source of supplementary roughage in years when perennial crops fail to produce enough forage because of drought. Oats is the best cereal crop to use for pasture or hay. Late and mid-late varieties of oats produce more forage than early varieties. Maximum feeding value

is obtained by cutting cereals in the dough stage. If cut at the milk stage, however, yields will be only slightly less and there is a much better opportunity of getting a profitable second crop, especially with good fall rains.

Other Annuals such as corn, millet, sorghum, sorghum almum, safflower, Kochia, emmer, and spelt are useful forages in various parts of the world but are much inferior to oats as forage crops in Saskatchewan. Dwarf Essex rape is a crop which can be used for hog pasture, but for other classes of livestock there is a danger of bloating.

GRASS-LEGUME MIXTURES

(See Tables 1, 2, and 3 for recommended mixtures and rates of seeding)

Whenever possible it is advisable to grow a grass-legume mixture. Alfalfa is the legume most generally used in mixtures, although sweetclover and alsike clover may be used under certain conditions. Compared to grass sown alone, a grass-legume mixture produces a better balanced feed and is higher yielding over a period of years. Grass-alfalfa mixtures are superior to grasses alone from the standpoint of soil improvement. Grasses grown alone become sod-bound and yields drop sharply in stands 3 to 5 years old. In contrast, grass-alfalfa mixtures do not become sod-bound as long as the alfalfa remains in the mixture. Grass-alfalfa mixtures will yield 2 to 4 times as much as grasses seeded alone when such become sod-bound. Compared to legumes alone the grass-legume mixture cut for hay is more easily cured, and there is less danger of bloating on pasture.

In a large measure the advantage of using alfalfa in mixtures is dependent on the alfalfa seed being properly inoculated. See Seeding Practices—Inoculation of Legume Seed.

Mixtures of grasses with or without alfalfa are often desirable to obtain increased adaptation and provide production over a longer seasonal period or a greater number of years. Single crops vary in soil requirements and in tolerance to flooding and salinity. On undulating areas mixtures will usually give more complete stands than single grasses.

SEEDING PRACTICES

A uniform stand is of the utmost importance. Stands need not be thick, but should have at least one plant per square foot.

Choice of Seed.—In purchasing forage crop seed there is a danger of introducing serious noxious weeds. This danger may be avoided by using Registered or Certified seed which comes from inspected fields.

Scarification of Sweetclover Seed.—Sweetclover seed will not germinate unless it is scarified. Scarification consists of chipping or cracking the seed coat. At least 95 per cent of the seeds should be scarified. The proportion of scarified seed in a sample can be determined by placing a small quantity in water. In 24 hours the scarified seed will swell to at least twice the normal size. Seed may be scarified by running it through a feed grinder with the plates set just far enough apart so as not to grind more than a small proportion of the seed.

Alfalfa, red clover, and alsike clover seed do not require scarification.

Inoculation of Legume Seed.—Sweetclover, alfalfa, alsike clover, red clover, and birdsfoot trefoil should always be inoculated before seeding. Inoculation enables the legume to take nitrogen from the air and fix it in the nodules on the roots. Bacterial culture for inoculating seed is available from seed companies and directions for applying are on the container. The crop for which the inoculum is required should be stated when ordering. Bacterial culture should not be used after the date of expiration stated on the package.

Fungicides and Insecticides.—Inoculated seed should not be mixed with wheat or other grains that have been treated with any fungicide that contains mercury. Certain non-mercuric compounds such as Captan and Arasan may improve the emergence of legume seedlings and are less injurious to the inoculum. If they are used, the fungicide should be applied well in advance of seeding and the bacterial culture applied a few hours before seeding. Fungicides have not shown a consistently beneficial effect on the emergence of grasses and legumes in Saskatchewan.

Grass seeds are highly susceptible to damage from insecticides. However, bromegrass may safely be treated with 2 ounces of a 50 per cent wettable powder of aldrin, dieldrin, or heptachlor

per 8 pounds of seed. Other grasses appear to be damaged by these concentrations. Other grasses and bromegrass may be treated with ½ ounce of a 10 per cent concentration of these insecticides, or gamma BHC, per pound of seed. Prepare this by mixing one part of a 50 per cent dressing with four parts of flour. If companion crops are used, treating the grain may be safer and more effective than treating the forage crop seed directly.

Condition of the Seed Bed.—It is essential that the seed bed be firm, whether summerfallow or stubble land is used. A firm seed bed encourages shallow seeding and provides better moisture conditions near the surface. Summerfallow and recently worked stubble land should be packed before seeding. Stubble land is usually firm enough if it is not worked before seeding. The choice of stubble land or fallow as a seed bed for forage crops depends on several factors. Fall seeding should only be done on stubble land, while spring seeding can be done on either summerfallowed or stubble land. Stubble land need not be worked if seeded in the fall, but if seeded in the spring it may require some cultivation to obtain a weed kill. Worked stubble should be packed to ensure a firm seed bed. Cereal companion crops should not be used in stubble land seedings. Summerfallowed land as a seed bed should generally be confined to spring seeding. Seeding on fallow without a companion crop gives rapid forage growth and ensures a better stand the following year. However, a companion crop on fallow land reduces the danger of soil drifting and usually provides a good crop of annual hay the first year.

Row Spacing.—For forage production seeding in rows spaced 12 to 18 inches apart is strongly recommended in the Brown and Dark Brown Soil Zones. If seeded in 6 to 7 inch spacings, the crop may be too short to mow in a dry season.

In the Black and Grey Soil Zones 6 to 7 inch spacings are recommended.

Depth of Seeding.—Shallow seeding of grass and legume seeds is absolutely essential if satisfactory stands are to be obtained. Deep seeding has probably resulted in more failures than any other single factor. The seed of all grasses and legumes should be sown less than one inch deep. With a grain drill it is possible to obtain this shallow seeding only when the land is firm and there is practically no pressure on the discs. Where necessary the pressure spring on each furrow opener can be released by removing the pressure spring keeper pins. The importance of a firm seed bed cannot be overemphasized.

Time of Seeding.—The best time to seed will depend on various factors, the most important of which are the condition of the land to be seeded, the insects present, and the moisture conditions. It is hazardous to seed grasses or legumes under moderate to heavy grasshopper infestations. (Consult annual grasshopper forecast.)

Spring Seeding.—It is recommended that spring seeding be done as early as possible. This is particularly important in the Brown and Dark Brown Soil Zones and on the light loams and sandy soils of all zones. In the moister areas, seeding may be delayed as late as June with reasonable chance of success.

With alfalfa and sweetclover in years and in areas where cutworms are a severe pest, it may be advisable to delay seeding until early June to escape damage. In nothern areas where the danger of late spring frosts exists, seeding of legumes should be delayed. Summerfallow should always be seeded in the spring.

Late Fall Seeding.—The object of seeding just before freeze-up is to ensure that germination will not occur until the following spring. The young seedlings can take full advantage of moisture from the winter snowfall. Late fall is often an excellent time to seed spring flooded areas. All grasses and alfalfa may be seeded in the late fall, but not sweetclover. Seeding into a cover of stubble or weeds is recommended.

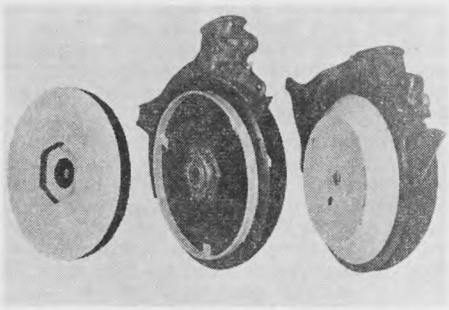
Companion Crops.—For spring seeding on well prepared land, a companion crop may be used. In all areas, drilling the companion crop first and then the forage crop separately and, if possible crosswise, results in better stands than if the two kinds are sown in the same drill rows.

Wheat, oats, and barley in that order are preferred as companion crops. Fall rye sown at the normal time may be used with the forage crop sown late in the fall or the following spring. The companion crop should be sown at not more than ½ to ⅔ the regular rate and should be cut to leave a high stubble.

Methods of Seeding

Drilling.—Drilling the seed into the soil is better than broadcasting. The press drill gives best results. The tiller combine and discer are not recommended because they generally seed too deeply. Grass seeder and depth control

attachments may be secured for the grain drill to permit more accurate rate and depth of seeding. (See photograph). Every precaution must be taken to avoid seeding the forage crop too deeply.



Depth control attachments for drill discs. From left to right, a plywood clamp-on type, a flange ring spot welded to disc, and a commercial 'pie plate' clamp-on type.

For most grasses and mixtures start with a setting of 1 bushel on the wheat scale, then try the drill out on a hard surface. Count the number of seeds that drop per foot of row and then adjust the setting to seed 30-35 seeds per linear foot for 12" - 18" row spacings, and about 20 seeds per linear foot for 6" - 7" row spacings. For larger seeded crops like bromegrass, it will be necessary to open the drill more, while for smaller seeded crops, such as crested wheatgrass, the setting will likely have to be reduced.

Another method of checking the setting is to fill the cups level with the bottom of the box. Then add enough seed at the recommended rate to cover 1 acre or 1 drill round. By checking the amount of seed in the box as the acre or drill round is being seeded it can be determined whether the setting is correct or too light or heavy. If a change is necessary, it can be attained by repeating this process one or more times.

In seeding with or without a companion crop it is advisable not to fill the drill box over ⅓ full or bridging may occur. A man should ride on the drill to watch the flow of seed and agitate any runs where blockage occurs.

It is difficult to drill a legume alone at the recommended rate, especially with old drills. Mix the seed with cracked grain from which the finer particles have been sifted out or mix it with a small amount of live grain (about 10 pounds per acre). The drill can then be calibrated as recommended for grasses and mixtures.

Broadcast Seeding.—Broadcast seeding often is practised in areas of good rainfall and it may be advisable on rough ground or on very loose soil where the depth of seeding cannot be controlled properly. Small-seeded crops such as alsike clover or timothy may have to be seeded broadcast because of the danger of seeding too deeply with a drill. A Cyclone seeder is a valuable aid for broadcasting. Seed may be broadcast by a grain drill with or without a fertilizer or grass seed attachment or with a tiller combine or discer. When the tiller combine or the discer is used the grain spouts should be removed entirely.

All broadcast seeding should be followed by harrowing. Packing after harrowing is advisable.

Herbicides.—Weeds are of critical importance in young seedling stands of forage crops. Companion crops are often used to help control the strong growth of annual weeds, but they also compete with the delicate forage seedlings. Herbicides may eliminate the need for a companion crop in the control of weeds. Newly seeded stands of alfalfa, red, white and alsike clover can be safely sprayed with 4 to 5 ounces of 2,4-D amine or MCPA amine and up to 16 ounces of MCPB sodium salt or 24 ounces of 2,4-DB sodium salt per acre. **(Neither 2,4-D esters nor MCPA esters should be used on seedling legume stands.)** Seedling stands of the above legumes should be from 2 to 4 inches in height at time of spraying. Treatment later than this is not recommended.

Early germinating annual weeds such as Russian pigweed can be controlled in established stands of alfalfa by using 8 to 16 ounces of 2,4-D or MCPA ester per acre before spring growth of alfalfa starts.

Sweetclover is more susceptible to damage by the herbicides than the other legumes. When the seedling stand is excessively weedy, however, it may be sprayed (2 to 4 inches of growth) with 4 to 5 ounces of MCPA amine per acre. Sweetclover in the bud and flowering stage is very susceptible to the present herbicides, and seed yield may be reduced greatly by 2-4-D drift.

New seedlings of brome and crested wheat which have made 4 inches of growth may be treated with up to 16 ounces of 2,4-D ester per acre with no harmful effect. Crested wheatgrass is

more resistant than bromegrass. Established fields for seed production should be treated as early as possible, and not after the early shot blade stage. Perennial weeds in grass stands should be treated immediately after harvest with 16-32 ounces per acre of 2,4-D ester.

GENERAL MANAGEMENT OF GRASSES AND LEGUMES

Rejuvenation of Old Stands.—The yield of perennial grasses and legumes tends to decrease after the first 3 or 4 years, especially if little legume remains in the stand. (See Table 4). Therefore, new fields should be seeded from time to time and old ones broken up. Where this is not practical old stands of certain grasses may be made more productive by cultivation, reseeding, manuring or fertilizing, or a combination of these.

TABLE 4.—HAY YIELDS OF GRASS STANDS OF VARIOUS AGES AT SASKATOON. GRASSES SEEDED ON SUMMERFALLOW WITHOUT A COMPANION CROP

Crop Year	Average Yields in Tons per Acre*	
	Fairway crested wheatgrass	Bromegrass
1	1.44	1.27
2	1.43	1.49
3	1.50	1.32
4	.75	.78
5	.80	.64
6	.61	.62
7	.54	.53
8	.33	.43
9	.28	.42
10	.28	.42

*Averages based on 8 tests of crested wheatgrass and 10 tests of bromegrass harvested between 1926 and 1956.

Bromegrass which has become sod-bound may be improved by shallow plowing, one-way discing, double discing, or cultivating with a narrow tooth cultivator in the spring. This may be followed by seeding with alfalfa at 2 or 3 pounds per acre. In dry seasons complete surface destruction of the grass is not advisable as this may kill out the bromegrass completely.

Fields of crested wheatgrass, which have become too dense to produce good stands, cannot be improved by tillage and should be broken, summerfallowed, and reseeded, preferably to a grass-alfalfa mixture.

Alfalfa which has thinned out may be cultivated with a narrow toothed cultivator and over-seeded with a grass. Crested wheat grass is the most suitable grass to use on the brown and dark brown soils and bromegrass on the black and grey soils.

Fertilizers

Grasses.—Where grasses are grown for seed, apply 100 to 200 pounds per acre of ammonium nitrate (33.5-0-0) or 150 to 300 pounds of ammonium sulphate (21-0-0). In the Black and Grey Soil Zones these rates may be increased by 50 per cent. These fertilizers are usually broadcast on the surface. August applications are recommended for Russian wild ryegrass and early September application for other grasses. These fertilizers also may be used to improve hay or pasture production although in the Brown and Dark Brown Soil Zones a response will be obtained only in years of good moisture. For pasture or hay apply fertilizers in the fall or the spring. The use of legume mixtures is a more economical way of improving the forage yields of grasses than by using fertilizers.

Legumes.—Fertilizers have not shown any consistent benefit on legumes except from the use of sulphur in the Grey Soil Zone, especially on sandy soils of this zone. In seeding legumes with a companion crop use 50 to 60 pounds per acre of 16-20-0 ammonium phosphate. For established stands of legumes on sandy and sandy loam soils use gypsum at 40 to 100 pounds per acre, or ammonium sulphate (21-0-0) at 30 to 80 pounds per acre, or 16-20-0 at 50 to 150 pounds per acre. The lower rates are recommended for seed production and the higher rates for hay or pasture. Applications may be made in the fall or early spring.

Grass-legume Mixtures.—No fertilizer is recommended for mixtures except in the Grey Soil Zones. On grey soils apply sulphur fertilizers as for pure legume stands. In other soil zones where mixtures are over 3 years old and contain little legume the use of nitrogen fertilizers as for pure grass stands may prove beneficial.

Irrigated Grass-legume Mixtures.—Use of ammonium phosphate (11-48-0) at 100 pounds per acre is recommended for trial.

Barnyard Manure.—Application of 10 to 15 tons of barnyard manure per acre at 4 to 5-year intervals will increase the yields of pasture or hay.

Time to Cut

Cutting or heavy grazing of grasses and alfalfa during the critical period from mid-August to the end of September may result in winter killing and reduced production the following year. At this time the plants store root reserves that are necessary for winter survival and vigorous growth in the spring. Cutting or heavy pasturing late in the season stimulates growth which uses up the root storage and is too late to build up additional reserves. Cutting early in October, however, is not followed by regrowth and usually does not injure the stand if there is an adequate snow cover. This late cutting is often difficult to cure for hay but does make good silage.

Snow Plowing

Outside the Chinook area of the Province, the hay yield of grasses and legumes has been increased up to 50 per cent by snow plowing. Grasses and legumes respond to such treatment to a far greater extent than cereals. The use of the snow plow on hay, pasture or seed fields is recommended.

Breaking Grassland

It is recommended that forage crops be left down for short periods of time especially in the black, transition black, and grey soil zones. There is a sharp drop in forage yield three or four years after seeding down. During this time substantial amounts of root fibre have been built up in the soil. Three-year-old stands of crested wheat or bromegrass will add about 2.5 tons of fibre per acre foot of soil and five-year-old stands only about 3 tons. In comparison, native sod will have about 6 tons of root fibre per acre foot.

For best kills and greatest moisture conservation grasslands should be broken late in the fall if moisture conditions permit, left rough, and fallowed all the following year. In the Black and Grey Soil Zones a crop of hay may be taken and the field broken by July 15. The field should be fallowed the rest of the year.

Following the breaking of grasslands, wireworms may be a problem. They can be controlled by treatments on seed grain. Yields of cereals following cultivated grasses are likely to be reduced for one or two crops. This is particularly noticeable following pure stands of bromegrass. High nitrogen fertilizers such as 27-14-0, 23-23-0, or 24-20-0 at 60 to 80 pounds per acre will help correct this condition. It has also been noted that yields of cereals following legumes or grass-legume mixtures are less likely to be lowered.

Control of Sweetclover

Because of its hard seed coat, sweetclover seed may live in the soil many years before germinating. This crop thus tends to volunteer and, if volunteer plants occur in wheat fields, the wheat may be degraded because of sweetclover taint. To avoid or reduce this danger the following practices are recommended:

(a) Use only well scarified seed.

(b) Seed shallow and early.

(c) After removing a crop of seed, cultivate immediately at a shallow depth and, if possible, summerfallow the next year.

(d) Cereal crops containing sweetclover should be sprayed with 10 to 12 ounces per acre acid equivalent of 2,4-D ester to eradicate the clover.

(e) Use the Cumino variety.

PASTURES AND PASTURE MANAGEMENT

NATIVE GRASS PASTURES

Good native grass pastures provide low cost grazing. Although relatively low in yield the grasses composing native grass pastures are high in feeding value and are liked by the grazing animal. In addition native grass pastures in good condition recover quickly from drought.

Carrying Capacity. — The carrying capacity of native grass pastures in good condition varies greatly. In the drier part of the brown soil zone from 30 to 35 acres are required to provide feed for one cow for the summer period. In the dark brown zone about 15 to 25 acres are required per cow. From 12

Close grazing reduces vigor of native prairie. Plants were treated left to right as follows: (a) not clipped, (b) clipped to 5-inch height, (c) clipped to 3-inch height, (d) clipped to 1½ inch height. Plants clipped at two-week intervals for five months and then removed from the soil.

to 15 acres per cow are required in the drier part of black soil zone. In most bush pastures from 10 to 25 acres are required. The carrying capacity may be summarized in terms of acres required per cow per month of grazing as follows:

Brown soil zone	3-6 acres
Dark brown soil zone	2.5-4 acres
Drier part of black soil zone	2-2.5 acres
Moist black and grey soil zone	1.5-3 acres

Where native grasses are in poor condition their carrying capacity is lower than stipulated above and more acres per animal must be provided.

Management.—The most important points in managing native grass pastures are season of use and rate of grazing. Pastures grazed too heavily, especially in the early spring, gradually become unproductive. (See photograph.) Good grasses disappear and pasture weeds increase. This trend develops slowly, but with continued overgrazing, weeds increase until they are more common than the grasses. An abundance of pasture sage, cactus, broom weed, golden aster, Canada thistle, and many annuals, indicates an overgrazed condition. As overgrazing progresses the yields of beef, milk, and other livestock products decreases, soil erosion accelerates, and grasshoppers find overgrazed fields excellent eggbeds. It must be recognized that native grasses have short growing seasons and are low yielders and consequently it is easy to overgraze them. Most small native grass pastures are seriously overgrazed.

An indication of proper rate of grazing native grass pasture is given under carrying capacity. Grazing so that some grass is left at the end of the season of an average growth year is a further guide. From 40 to 50 per cent of an average season's growth is considered an adequate carryover. Carryover is essential to the continuing good health and vigor of native grass pasture. It should be sufficient to trap snow, to produce seed to reseed the pasture, and to provide some feed for the following spring.

Careful management during the spring is especially important. Native pastures should not be grazed until the middle of June because they make slow growth during the spring. Native pastures are ready to graze about the time wild roses start to bloom. Where available, cultivated grasses and legumes should be used for the period before mid-June.

Uniform grazing is essential. Proper distribution of stock-watering sites, salt, and shelter ensures better use of pastures. Grasslands more than 1½ miles from watering sites will be undergrazed. Good shelters need to be scattered. Salt licks should be located away from water and re-located occasionally to attract livestock to undergrazed areas.

CULTIVATED GRASS PASTURES

Cultivated grass pastures produce two to three times as much feed as native grass pastures. The cultivated grasses or grass-legume mixtures may be used as the sole source of pasture or in combination with native grass pasture. The recommended crops and mixtures and seeding rates are given in Table 1.

Carrying Capacity.—Differences in soil moisture, soil fertility, age and thriftiness of stand result in marked differences in carrying capacity. However, as a guide, the carrying capacity of fairly young stands of grass-legume mixtures is approximately as follows expressed in acres required per cow per month of grazing:

Brown soil zone, 1.5 to 2 acres.

Dark brown soil zones, 1.25 to 1.5 acres.

Drier part of black soil zone and grey soil zone, 1 to 1.25 acres.

Moist black soil zone, 0.50 to 0.75 acre.

For older stands containing no alfalfa the acreage required per cow should be approximately doubled.

Management.—The rate of grazing is the most important factor in the management of cultivated grass pastures. As frequency and closeness of grazing increases, the yield obtained per season progressively decreases. At no time during the season should the grasses be eaten down closely. Particularly in the mid-August to freeze-up period the grasses should be allowed to make at least 3 to 4 inches of growth. This is most important in grass-alfalfa pastues.

In the more moist section of the Province, the yield of older stands can be increased considerably by proper fertilization. Recommendations in this respect are to be found in the section General Management of Grasses and Legumes-Fertilizers.

Grasses differ in their growth habits and seasonal palatability. Maximum value is secured by grazing them when their yield and palatability are greatest. Crested wheat is particularly valuable for early spring pasture. Brome grass and intermediate wheatgrass are productive and palatable throughout the summer. Russian wild rye grass is particularly useful for fall pasture.

Rotational grazing has shown no advantage over continuous grazing in Saskatchewan. Production may be increased by having separate fields seeded to different crops and rotating animals between fields in accordance with the growth of each field. Some suggested combinations are as follows:

(a) Sufficient acreage of a crested wheat-alfalfa mixture to carry the stock until mid-June followed by grazing on native grass pasture. It is advisable to separate the two pastures with a fence.

(b) A brome-alfalfa, or brome-crested wheat-alfalfa mixture may be used in combination with the native grass pasture as in (a) above. It is advisable to separate the pastures by fencing.

(c) Russian wild rye may be used in a third pasture field for fall grazing in combination with (a) or (b) above.

(d) A combination of separate fields of crested wheat-alfalfa, brome-alfalfa or intermediate wheat-alfalfa and Russian wild rye may be used to provide spring, summer and fall grazing respectively.

(e) In cases where only a single mixture, such as brome-alfalfa, is used throughout the grazing season it is advisable to divide the pasture into three or four fields by fencing. In years of high production, grazing may be confined to the first two or three fields and thereby permit at least one field to be harvested for either hay or silage.

Annual grain crops are valuable to supplement the perennial crops during the summer and early fall period. (See Annual Crops.)

Irrigated Pastures.—The crops and mixtures and rates of seeding recommended for irrigated pastures are given in Table 3. The fertilizer practice recommended is given under the heading General Management of Grasses and Legumes.

It is advisable to subdivide the irrgated pasture into four fields and rotate the animals between fields with an interval of 30 days between grazings. Grazing should begin in early May and a carrying capacity of over 2 cows per acre for 150 days can be expected on productive stands.

Bloat.—Bloat can occur on any feed but is more likely to happen on pastures containing legumes. There is no sure method of prevention, but livestock on alfalfa pastures throughout the year are less likely to bloat than those feeding on alfalfa occasionally. Practices which help prevent bloat are:

(a) Use the recommended pasture mixture (see Table 1.) **On dryland pastures the alfalfa seeding rate must be limited to 1 pound per acre in a mixture.**

(b) Allow livestock to become gradually accustomed to the pasture by turning them into the pasture when they are not hungry, and increasing the length of daily pasture period.

(c) Provide some dry hay or straw in the pasture or during the night.

IMPROVING SLOUGHS AND MEADOWS

Suitable mixtures of grasses and legumes for many of the varying conditions of flooding and salinity encountered in low-lying areas are given in Table 1. For locations where there is considerable variation in time of flooding it is recommended that the more complex mixtures be used. It may be

advisable to break and seed a test strip through such an area before breaking the whole area.

Areas in unproductive native grass or sedge cover should be plowed and worked down into a good seed-bed before seeding. Seeding directly into native sod is not advisable as the seeded crops take a long time to become established. A good practice is to grow a cereal the year after breaking and seed the grass into the stubble in late fall. Stony soils and peaty areas which cannot be plowed may be one-wayed deeply or worked well with heavy duty cultivators. On very heavy soils crusting may develop and prevent seedlings from emerging. On such soils late fall seeding is desirable. Otherwise, broadcast the seed in the spring and cover lightly. Seed of the recommended grasses (Table 2) will stand almost as much flooding as the grass plants.

Peaty soils require special attention. Surface drainage is the first requirement. Heavy pasturing for a few years prior to breaking is beneficial as packing and manuring is accomplished by the grazing animals. After breaking and before and after seeding, the peat should be heavily packed.

In the black, transition black and grey soil zones sloughs used for hay may become polluted with dandelions. Spraying with 2,4-D should eliminate the dandelions and restore the productivity of the grass.

SEED PRODUCTION

Fields intended to produce seed should be free or comparatively free of weeds. For grass seed production they should be completely free of couch grass. All sweetclover should be eradicated in and around fields intended for the production of seed of other legumes. Mechanical separation of couch grass seed from seed of other large seeded grasses, and of sweetclover seed from seed of other legumes is difficult or impossible.

Seed of high quality should be used in all seed production enterprises. The four classes of pedigreed forage seeds are: Breeders, Foundation, Registered, and Certified. Breeders seed is grown by plant breeding institutions and used to produce Foundation seed. Foundation produces Registered and Registered produces Certified. Certified seed is the class of seed preferred by the seed trade for use in hay and pasture seedings, and is the class of seed which commercial seed growers should attempt to produce. Foundation and Registered classes have higher isolation and purity requirements. Breeders seed of Canadian varieties is allotted by the Provincial Branch of the Canadian Seed Growers' Association to qualified growers. Foundation seed of varieties originating in other countries can best be obtained through the Canadian Seed Growers' Association, Ottawa. Regulations governing certified seed production can be obtained from the Plant Products Division, London Building, Saskatoon; the Saskatchewan Branch, Canadian Seed Growers' Association, c/o Saskatchewan Department of Agriculture, Regina; or the Canadian Seed Growers' Association, Ottawa.

Most grasses have given the highest yields when grown in rows 3 feet apart, especially in the Brown and Dark Brown Soil Zones. On the black soils good seed crops can be obtained from closer spacings. The use of a companion crop may cause serious reductions in the seed yields of grasses the year after seeding. Where rapid establishment is wanted the companion crop should be omitted and weeds controlled with herbicides (See Seeding Practices—Herbicides). Spraying for weed control in the year of seed production must be done with caution as there is danger of damaging the seed set.

Fertilizer applications often benefit grass seed production. Recommended rates range from about 100 to 300 pounds per acre of 33.5-0-0 (ammonium nitrate) or 150 to 450 pounds per acre of 21-0-0 (ammonium sulphate). Fertilizers should be applied in August or September to benefit the next year's seed crop. Crested wheatgrass may be fertilized until freeze-up. The lower rates are more practical in the Brown and Dark Brown Soil Zones and the higher rates in the Black and Grey Soil Zones. Under favorable conditions 1 pound of fertilizer used may result in an equivalent 1 pound of extra seed produced per acre.

Most grasses shatter their seeds readily as seeds approach maturity. Seed may be mature and shattering even though the leaves of the plant are still green. Strong winds at this stage will cause serious losses of seed. As grass crops approach maturity they should be examined daily for evidence of shattering. If a few heads are struck lightly

across the palm of the hand and there is some shattering, then cutting should commence.

Insect pollination is an important factor in legume seed production. Native pollinators are seldom present in sufficient numbers to give adequate pollination. Although honeybees are relatively ineffective on alfalfa in Saskatchewan, they are very effective in providing pollination and maximum seed production in clovers. Every hive of bees located near a clover field increases seed yields but the seed grower will likely have to arrange with a commercial beekeeper to provide sufficient honeybee colonies. These should be placed in small groups throughout the field when the plants are beginning to bloom. If insecticides must be applied, notify the beekeeper.

In harvesting and threshing forage crops, straight combining is not generally recommended but may be used on crops that do not shatter readily. If the crop must be straight combined, then the seed should be dried before storing.

The best method is to swath the crop and thresh with a combine; the binder and threshing machine may also be used. A rub-bar type of cylinder is preferred because it does not break up the straw excessively and consequently the return elevator is not clogged so easily. However, a spike tooth cylinder machine may be used. For grass crops, the cylinder and concave teeth should be set fairly wide apart or the concave teeth removed for very dry conditions. For legume crops the concaves should be set up close. For all types of combines and threshing machines the cylinder speed should be reduced for grass crops and increased for legume crops. The wind blast should be reduced for grasses but this may not be necessary for legumes. The adjustable sieve should be set in a relatively flat position and the back board lowered sufficiently to allow the straw to pass over it. This prevents too much broken straw from going into the return.

Seed of grasses and legumes can be cleaned successfully on the farm with a fanning mill provided the proper selection of sieves is made. Companies selling cleaning machinery can provide information on the selection of sieves for forage crops. It is desirable to run the seed over the mill at least twice. In the first operation the coarse straws and unbroken spikelets or pods are removed while in the second the weed seeds and finer inert material can be cleaned out. Commercial and Government seed cleaning facilities are available at several points in the Province where it is possible to have the seed cleaned. For further information on seed cleaning see the bulletin "Seed Cleaning in Saskatchewan."

GRASSES

Crested Wheatgrass seed may be produced in all soil zones although present production is found mainly in the Dark Brown Soil Zone. Seed yields are high for young stands but drop considerably after stands are 3 years old.

Seeding can be done in rows 12-36 inches apart, with a seeding rate of 6 pounds per acre at a 12-inch spacing and 2 pounds per acre at the 36-inch spacing. Crested wheatgrass should not be straight combined because the crop shatters readily. The crop is ready for swathing in late July or early August. Cut the crop when the heads are brown and the stems are still green. For further information see bulletin "Crested Wheatgrass."

Bromegrass seed production appears most successful on light textured soils in the Dark Brown and Black Soil Zones. As thin stands are more productive than thick stands a low seeding rate of 5 to 6 pounds per acre should be used and seeding done in 12-inch drill spacings. The crop is usually straight combined although occasionally there are severe losses from shattering. The crop is generally ready for straight combining the second week in August, and at this time heads and upper portion of stems are dark brown and seeds can be stripped off easily by hand.

Bromegrass for seed production should be fertilized at the low rate of 100 pounds per acre of 33.5-0-0 (ammonium nitrate) or 150 pounds of 21-0-0 (ammonium sulphate) in the Dark Brown Soil Zone. For further information see bulletin "Bromegrass Seed Production."

Russian Wild Ryegrass is an erratic seed producer due to poor heading in certain years. It should be grown in rows spaced 3 feet apart. Seed at a rate of 2 to 2½ pounds per acre. Applications of ammonium nitrate fertilizer (100 to 150 pounds per acre) usually give a heading response. The fertilizer should be applied immediately after the seed crop has been harvested. Russian wild ryegrass shatters its seed very readily and if possible should be cut when the seed is in the late dough stage with a

binder or swather. It threshes very easily and some growers have straight combined it successfully. If this is done seed drying facilities must be available. For further information see bulletin "Russian Wild Ryegrass."

Slender Wheatgrass is adapted on the moister locations anywhere in the Province. It should be grown in solid plantings (12" rows) because yields decline after the second crop year. The grass shatters its seed and should be swathed or cut with a binder when the seed is in the late dough stage.

Intermediate Wheatgrass can be grown for seed anywhere in the Dark Brown and Black Soil Zones and in moist locations in the Brown Soil Zone. Because it produces good yields of seed for only about 2 or 3 years after seeding it should be drilled in rows 12" or 18" apart.

Seed at 12 pounds per acre for 12-inch rows and 8 pounds per acre for 18-inch rows.

There is considerable danger from shattering and it is advisable to cut with a binder or swather before the seed is brittle and thresh about a week later. As this crop resembles couch grass the grower **must make sure that the seed he purchases is absolutely couch free and that it is planted on couch free land.**

Reed Canary Grass.—This crop matures seed satisfactorily but shattering is so serious that most seed crops are lost. One windy day as the seed crop approaches maturity will cause the loss of practically all the seed. In addition seedheads may fail to form because of drought, winter damage, or because the stand is sod bound. It is recommended that seed production be attempted on a small scale so the crop can be swathed or cut at the critical stage between maturity and shattering.

Creeping Red Fescue.—Little creeping red fescue seed is produced in Saskatchewan, although tests indicate that the grass is adapted to northern areas. For further information see bulletin "Creeping Red Fescue for Seed Production," Experimental Farm, Beaverlodge, Alberta.

Bluegrass. — Recently growers in northeastern Saskatchewan have produced seed of Merion bluegrass. However, the Kentucky strain should be considered also, since it has more winter hardiness and disease resistance than Merion. In southern areas the difficulty of obtaining stands prevents seed production.

Timothy.—The Climax variety of timothy developed at Ottawa may be grown successfully for seed in the more moist areas of northern Saskatchewan. It appears impractical to attempt seed production in the Brown, Dark Brown, and drier parts of the Black Soil Zones. Seeding should be at a rate of 6 to 7 pounds per acre in 6-inch drills or broadcast. The crop generally is swathed and picked up as shattering losses are high for straight combining. Cylinder speed and concave settings should be adjusted to give a minimum of dehulled seed. Seed without hulls loses germination rapidly and is downgraded.

LEGUMES

Alfalfa seed crops can be produced wherever conditions for seed setting are suitable. Successful growers of alfalfa seed are found throughout Saskatchewan wherever attention is given to the proper location of the field and to the care and management of the crop.

Seed setting in alfalfa depends primarily on the presence of wild bees to trip and cross-pollinate the flowers. These insects nest in woodland or unbroken prairie and, consequently, seed fields should be located where such conditions exist. Field size is important and usually should not exceed 25 acres with at least one side adjacent to prairie or woodland.

Sulphur-bearing fertilizers often are necessary in the Grey Soil Zone, especially on sandy and sandy loam soils. (See General Management of Grasses and Legumes-Fertilizers.) Insect pests, particularly plant bugs, frequently cause havoc in alfalfa seed fields throughout the Province. They can be controlled with insecticides such as DDT. Early spring burning of the alfalfa stubble and trash will control certain injurious insects, and also will assist in the control of the fungi causing leaf and stem diseases. Annual weeds such as Russian pigweed should be treated with herbicides early in the spring. (See Methods of Seeding-Herbicides.)

Alfalfa is ready to harvest from early September onward. It may be cut with a binder and threshed or swathed and threshed with a combine. If either method is used it may be possible to avoid damage from heavy fall frosts. Straight combining is a general practice also but it is usually necessary to leave the crop until frost has destroyed all or most of the green growth.

For more detailed information see the bulletins "Alfalfa Seed Production in the Prairie Provinces" and "Control of Plant Bugs in Northern Alfalfa Seed Fields."

Sweetclover should be cut when about two-thirds of the pods have ripened which is usually from mid-August to early September. It should be cut with a swather, preferably on a dull day or after a very light dew, but not straight combined. The concave adjustment should be such as to leave the pods on most of the seeds since weed seeds can then be more readily removed. The pods are removed in scarifying the seed.

Honeybees are very effective in pollinating sweetclover. For good seed yields it is important to provide at least one colony per acre. Two or three colonies will usually give even greater seed increases although the honey yield per colony will be lowered.

Sweetclover is very susceptible to 2,4-D damage in the flowering stage. Even a poorly cleaned weed sprayer used to apply DDT, or 2,4-D wind drift from an adjacent area, may drastically reduce seed yield.

For further information see bulletin "Sweet Clover in Western Canada."

The True Clovers.—Red and alsike clover are seldom grown in Saskatchewan for hay or pasture. They are, however, profitable seed crops in certain parts of the Black, Greyish Black and Grey Soil Zones. Seed yields vary widely but a careful grower can expect 300 to 400 pounds per acre from red or alsike clover. Rates and kinds of fertilizers as recommended for alfalfa are recommended for these crops also. Honeybees are very effective in pollinating the true clovers and thus increasing seed yield. At least one colony of bees per acre of clover should be provided, and heavier concentrations of two or three colonies per acre are likely to give even greater seed yields.

Red Clover should be grown on land well-favored with moisture but with good drainage. It is usually ready to harvest about the middle of August or when the heads are dark brown or black in color. Straight combining may result in loss of seed through over-ripe heads tending to break off. A better method is to use a mower with a windrowing attachment or a swather followed by a pick-up combine. To get good separation of the seed the crop must be dry, the concaves set close, a high cylinder speed maintained and the cylinder not overloaded.

Alsike Clover is a heavy seed producer but must be grown in favored locations. Rather poorly drained soils and locations where water will collect for one or two weeks in the spring are preferred. The crop usually is mature early in August. Because it shatters very easily, alsike should not be left for combining. The best method is to use a mower with a bunching attachment, preferably when the crop is tough after dew or rain. The bunches may be picked up and threshed with a threshing machine. A swather followed by a pick-up combine may be successful in good stands. Alsike threshes easily if the crop is dry and the machine not over-loaded. Handling the crop before threshing should be avoided whenever possible because of losses from shattering.

PRESERVATION OF FEED

The most important single controllable factor determining the value of feed is the stage at which it is harvested. This is true irrespective of whether the feed is preserved as hay or as silage. As crops advance from the early growth to the mature seed stage they become progressively less valuable as feed. The decrease in feeding value is primarily due to a decline in protein content and digestibility and an increase in fiber content. The decrease of such constituents as phosphorus is also important. The gains in weight or milk production which will be made on feeding the roughage and the general health of the animals are determined to a large extent by protein and fiber content and the digestibility of the roughage. It is possible to offset low feeding value of roughage by feeding protein supplement and/or grain but such practices are costly and decrease the net profit compared to feeding good quality roughage. Consequently it is important to harvest the feed at the start of flowering. This provides a good balance between feeding value and yield. Many of the grasses flower during the last week in June or the first week in July and the legumes start flowering slightly earlier than the grasses. **Cutting of grass-legume mixtures should be started when the legumes begin flowering.** The longer harvesting is delayed beyond the above stages the greater the loss in feeding value and there is little or no increase in yield per acre.

HAY

Aside from the stage of harvesting the most important factors affecting the feeding value of hay are the rapidity of the drying or curing process, the amount of leaf retained, and the dryness of the feed as it is placed in storage.

Rapid curing reduces losses of feed value. Slow drying, and particularly exposure to rain and dew, results in losses which under very adverse conditions may amount to as much as 40 to 50 per cent of the feeding value. Rapidity of drying is determined almost entirely by weather conditions and control of losses caused by slow drying is difficult or impossible. However, by mechanizing the operations the handling of the crop can be speeded up as much as two or three times and thus full advantage can be taken of favorable weather.

Some increase in speed of haying may be secured by cutting the crop with a grain swather or a mower with a windrowing attachment. Although drying is somewhat less rapid in the windrow than in the swath, the elimination of the one raking operation speeds up the work. When a grain swather is used the width of cut should be regulated to make a windrow which is relatively light. If the windrow is heavy, drying will be slow.

The feeding value of the leaves is considerably higher than that of stems. Loss of leaves in handling decreases the feeding value. Such losses are particularly likely to occur in legume hay. If legumes are cut with a mower the hay should be raked into windrows within a few hours after cutting. If the hay is to be bunched this should be done before it is completely dried.

If feed is baled or placed in storage before it is sufficiently dry, heating and the development of mould will cause losses in feeding value. If the hay is to be baled it should be at least as dry and preferably drier than if it was to be put up as loose hay. If the crop is to be stored as chopped feed it should be even drier than hay to be baled. If feed is to be stored in the open the stack should be located on high, dry locations.

Avoiding spoilage in curing sweetclover hay is particularly important. If the hay becomes musty or mouldy during curing it is likely to reduce the clotting time of the blood of animals for which this type of feed is the major roughage. In severe cases animals so fed may bleed to death. If known or suspected to be mouldy, sweetclover should be fed in limited quantities and should not be fed at all for a few weeks prior to an operation or parturition. As the Cumino variety does not contain coumarin spoiled hay of this variety is no more dangerous than spoiled hay of alfalfa.

SILAGE

The primary advantage of silage over hay is that the problem of curing is eliminated. The feeding value of good silage is equivalent to that of good hay made from the same crop. Two types of silos in greatest use in Western Canada are the trench and bunker silos. If a suitable hill is available to give drainage then the trench silo is probably most satisfactory. If the land is level then a well braced bunker silo placed in a well drained location should be used. Difficulty may be experienced in filling an above-ground silo to a desired depth. This can be overcome by using an earth-filled ramp at one end or using a front end loader on a large tractor.

Silage Making

The three most important points to consider in making silage are, (a) moisture content, (b) fineness of cut, (c) packing.

Moisture content of the crop is most important because the percentage moisture to a large extent determines how finely the silage should be cut and how heavily it should be packed.

Silage should have 65 to 75 percent moisture when it enters the silo. At a moisture content greater than 75 per cent plant juices will seep out of the silage and food value will be lost. In addition, the silage may become rank smelling and the cattle may refuse to eat it. When the moisture content is too low moulds develop and spoilage results. A rough index of moisture content may be obtained by tightly squeezing a handful of the chopped crop into a ball. If no moisture oozes out between the fingers and if the ball does not expand very quickly, the moisture content is probably about right. If the ball falls apart when the pressure is released, then the moisture content is probably below minimum.

If the moisture content is too low, water should be added to bring the silage within the 65 to 75 percent range. The material should be cut fine enough to facilitate packing and feeding. If the

forage tends to be too dry, a very fine cut (about ½ inch) and heavy packing will help preservation. On the other hand, a high moisture content requires that the cut be lengthened (up to 2 or 3 inch) and the packing done evenly but not too hard. An additional corrective for high moisture content is to mix about 150 pounds of ground cereal grain per ton of silage. This amount of grain will reduce the moisture content of the silage by approximately 5 per cent.

Temperature of the ensiled crop is important. A desirable temperature range 2 weeks after ensiling is 100° to 125° F. Where no thermometer is available a rough test can be made. At about 1½ feet below the surface of the silo the temperature should be not less than body temperature and not hotter than the hand can bear for one minute. If the silage is too dry or not packed sufficiently, the temperature will rise to 130° F. or more. The result will be brown silage or even "firing," with a resultant loss in food value. Properly ensiled silage will come to a temperature between 60° and 80° F. during the winter months which will prevent freezing. If silage is too wet and too finely cut, then excessive packing may prevent the normal rise in temperature, with the production of "cold silage" and feeding difficulties from freezing during the winter. If the moisture content is low and temperatures rise, packing each day for 10 days to 2 weeks is good practice.

Silage Crops

Legumes and Grass-legume Mixtures.—Legumes such as sweetclover, alfalfa, and red clover make better silage when ensiled in combination with grasses or grain crops. Better conditions for fermentation are provided by such combinations than when the legume is used alone. If the legume is grown alone, about 75 to 150 pounds of chopped grain per ton of silage may be added as a preservative. The grain should be evenly mixed with the green material as it goes into the silo.

Sweetclover tends to be above the maximum moisture content when grown in the northern and eastern parts of Saskatchewan. For this reason it is often advisable to delay harvesting the sweetclover crop until flowering is well advanced. If the moisture is still too high, it should be allowed to wilt for a period in the swath before being picked up by the forage harvester. Sweetclover is coarse stemmed and should be packed as heavily as possible. When sweetclover is ensiled special care should be taken that spoilage will not occur in the silage. If dark brown or mouldy sweetclover is fed in considerable quantity for a period of time, "sweetclover disease" may result. Animals with this disease hemorrhage when injured or operated on and may bleed to death. Besides using good methods in preparing sweetclover silage it is recommended that a top layer of at least 1 foot of silage be made from some crop other than sweetclover. When this is done the mouldy and dark brown layers are not likely to extend into the sweetclover silage.

The Cumino variety does not contain coumarin and therefore will not cause "sweetclover disease."

Alfalfa alone tends to have about the right moisture content, ranging from 65 to 75 per cent. Generally alfalfa should be cut at the early flowering stage and this crop should not be allowed to wilt between cutting and being placed in the silo. Alfalfa should be packed evenly and thoroughly, but not too heavily.

Grasses.—Grasses will make good silage providing they are cut before the moisture content is too low; that is, before flowering. Crested wheatgrass at flowering time has approximately 55 per cent moisture. Bromegrass and intermediate wheatgrass have around 60 per cent moisture at flowering. The desired moisture level of silage of 65 per cent can be obtained by cutting these grasses in late June, mixing with more succulent legumes, or adding water to bring the moisture level up to the minimum.

Annuals.—Oats (also wild oats), wheat, barley, or rye will make good silage if ensiled when the foliage is still green and the grain is in the late milk stage. Corn and sunflowers may be used for silage although yields are generally lower than those of oats or barley, and in addition special forage harvester equipment is needed.

Feeding Silage

Since silage is made from forage crops it should be regarded as a substitute for hay rather than grain. A mature animal of 1,000 to 1,200 pounds in weight requires about 50 to 60 pounds of silage per day if it is being fed as the sole roughage. A cubic foot of well packed silage will usually weigh about 40 pounds. Considering mature cattle and young stock in the herd, about 1 cubic foot of silage will be required per animal per day of feeding. Since silage may tend to be low in net energy and total digestible nutrients, beef cattle may require some good hay as part of the ration, while dairy cows which are usually better housed and require more protein usually do well on silage alone.

Silage may be self-fed but more commonly it is transported to a feeding lot. A front end loader may be used for loading the silage. A good, solid, well-drained floor is necessary for self-feeding from the silo. Some farmers use silage as a supplement to summer pasture. Silage seldom, if ever, causes bloat, hence it provides a means of utilizing a pure legume stand as a safe substitute for pasture.

The size of the herd will determine the dimensions of the silo or even whether or not a silo is practical. About 20 mature animals may be considered a minimum. There are three practical considerations that will determine dimensions as well as the number of animals: (1) If fed as the sole roughage, a 1,000-pound animal will eat about 60 pounds of silage per day, (2) one cubic foot of silage weighs about 40 pounds and (3) it is necessary to feed at least 2 feet of silage from the face of the silo each week to prevent frost penetration at the exposed surface. Thus to feed 20 mature animals for 200 days, the silo should be 15 feet wide and 50 feet long. The depth should be 10 feet to allow about 2 feet for packing and settling. For further information see bulletin "Silage in Saskatchewan."

Brome-alfalfa mixtures (right) outyield bromegrass grown alone (left), especially as stands get old.

Where trade names of products are mentioned in this "Guide" they are to be considered as examples and their mention does not necessarily constitute a recommendation.

HORTICULTURE

THE SASKATCHEWAN HOME GARDEN

Clear skies, long hours of sunshine and rich soil combine to provide favorable conditions for garden plant growth. Abundance of vegetable varieties, high quality fruits, a wide range of decorative trees and shrubs and brilliant garden flowers can flourish in Saskatchewan.

WINDBREAKS

Trees are an aid in (1) providing protection and comfort for man and farm animals; (2) preventing snow drifts in undesirable places and conserving it where it will benefit crop production and storage reservoirs; (3) reducing soil erosion and evaporation; (4) improving growing conditions for specialty and other crops difficult or impossible to produce in the absence of shelter.

Source of Planting Material.—The forestry stations of the Canada Department of Agriculture at Indian Head and Saskatoon (Sutherland Sub. P.O.) supply the following deciduous trees free of charge for farm planting: Several varieties of Poplar and Willow as cuttings; Manitoba Maple (Boxelder), Green Ash, American Elm, Manchurian Elm and Caragana as one and two-year-old seedlings. In evergreens, White Spruce, Colorado Spruce and Scots Pine are available in restricted numbers and for a small fee. All trees are shipped with carrying charges collect.

Application for trees should be made as early as possible within the calendar year preceding that of planting. Submit applications and enquiries direct to the Forest Nursery Station, INDIAN HEAD, Saskatchewan, or through your local Agricultural Representative Office.

Recommended Varieties and Their Uses.—**Willows** are recommended only for situations permanently supplied with subsoil moisture or for alkali-free areas subject to flooding during the growing season. Planting of field windbreaks in low or flooded areas is advisable in special circumstances only.

Poplars require a continuously moist soil throughout their life. Under such conditions, vigor will be maintained for a life-span of thirty to fifty years. Poplars will not tolerate flooding for more than a few days in the growing season. Because of their suckering habit, poplars should not be planted adjacent to gardens or cultivated fields.

American Elm, Manchurian Elm, Green Ash, Caragana and Manitoba Maple are the recommended kinds for farmstead and field windbreaks on well drained uplands.

Colorado Spruce, White Spruce and Scots Pine are particularly valuable as protection against cold winter winds and storms. The spruces will thrive for forty to fifty years on most upland soils. Colorado spruce is somewhat superior on the heavier clays. Scots pine is particularly adapted to the deep sandy loams or the submarginal lands, where moisture is continuously available in the upper two to four-foot layer.

Lilac, Tatarian Honeysuckle, Chokecherry, Saskatoon and several of the hardy **Plum and Apple** varieties have some windbreak value, as well as being a source of food for birds. These are not adapted to a great variety of soils and conditions, and the best in cultivation and management is essential in their culture.

Planning the Windbreak.—Planning begins with selection of the site and preparation of the soil. A well-drained fertile soil is desirable. Five acres is considered ample for all except the most extensive farm enterprises. Plant so that the accumulation of drifted snow will serve a useful purpose and so that the trees will protect drives and service yards. Windbreaks situated in depressions or on slopes where run-off water may be trapped will benefit greatly from the extra moisture. Three to five rows of deciduous trees are recommended for the exposed or windward sides. Desirable views from or toward the farmstead area should **never** be completely shut off. The place for evergreens is in rows or groups inside the main belt of trees. They should be placed at least twenty feet from the inside row of deciduous trees and not less than fifty feet from the main buildings and yard. **Preparation** prior to planting is important. The **best** in tilth and storage of moisture, as well as weed and grass eradication, is essential.

Mixtures are Desirable. — Desirable upland windbreaks are produced from either green ash or American elm alternated with Manitoba maple. Manitoba maple will provide a ground cover or shade, not supplied by either green ash or American elm, for the suppression of grass and weeds. Manchurian elm may be used to replace the Manitoba maple, and provide both a ground cover

Caragana and American Elm in a single row field belt. Illustrating the purpose of the shrub as a filler for the understory.

and a quickly growing tree. This elm has a similar rate of growth to that of poplar to a height of up to at least twenty-five feet and drouth resistance comparable to that of common caragana. Mixed plantings as outlined provide a plant association which will give an effective ground cover and a sheltering influence for the thirty to fifty-year life-span of the planting. Damage from insects and diseases is likely to be reduced by mixed plantings. Common caragana, alone, at one to three-foot spacings or alternated with either green ash or American elm at two to three-foot spacings is recommended for the outer or windward row to provide a continuous wind barrier from the ground level up. Poplar and willow are unsuitable for upland windbreaks. Further, they do not associate well with one another in a mixed planting, or with the other recommended kinds.

Spacing of Trees in Windbreaks.—The recommended spacing of trees in multiple-row windbreaks is four feet between the trees in the row. Where common caragana and other shrubs are used in the outer row, closer spacings are desirable. Rows should be four to six feet apart. Wider spacings may provide less shelter and may create a maintenance or weed problem.

In deciding between the two systems of spacing, four feet and eight feet or more between the rows, the planter must consider cultivation essential until a complete ground cover is established. Three to five years of maintenance will be required with narrow spacing, and ten years or more with the wider spacing. It is obvious that as branches lengthen, narrower implements will be required until a complete ground cover is established, and cultivation can be safely discontinued. It has been proven by wide experience that vigorous, serviceable and durable windbreaks can be established more economically by close spacing than by wide spacing. Mulching cannot be recommended as a substitute for cultivation.

Roadside and Field Windbreaks.—A single row of trees is recommended for roadside hedges and field windbreaks. Roadside hedges should be planted 150 to 200 feet from the centre of market roads and highways. At this distance they help keep the roads clear of snow during winter and hold drifts in the fields to supply additional moisture.

Field shelters at 20 to 40 rod intervals and 20 feet in height will conserve snow on 10 to 30% of the entire land area and give appreciable benefits in reduced soil erosion and evaporation. The protective range is estimated at 20 times the height of the trees to leeward, and considerable distance to windward as well. Manitoba maple, green ash and American elm alternated with common caragana or other shrubs in the proportion of 10 to 50% of the trees used will provide the desired permanent density and height. The varieties recommended can be expected to recover fully following storm, fire damage or slashing at ground level as a renovation practice.

Permission must be obtained from the Saskatchewan Department of Highways

to plant trees closer than three hundred feet from a provincial highway. The matter of roadside shelters bordering market roads might advantageously be discussed with local municipal representatives.

Roadside hedges located under power or phone lines should consist only of those kinds not exceeding fifteen feet in height.

Roadside and field windbreak planting may be carried out as a co-operative project under the Earned Assistance Program of the Saskatchewan Department of Agriculture. Information regarding this program is available from your Agricultural Representative.

Planting and Maintenance.—Although much tree planting and cultivation is still performed with hand tools, power tree-planters and standard field implements are used extensively for planting and cultivation of the trees.

Pruning.—The smaller trees used require no pruning at planting time. The larger trees of ash, elm and maple may be cut back before or immediately after planting, leaving twelve to fourteen inches of the stem above ground level. This treatment tends to balance root and top development, and usually results in a higher rate of survival of the trees. Pruning of established windbreaks is required only to repair injury, or to correct abnormal development.

Plowing of a deep furrow alongside tree belts is recommended when the roots compete with adjacent crops. A subsoiler with a three-point hitch, mounted on a tractor, will do an excellent job in the root-pruning of trees. Root pruning of poplars may not achieve the results intended.

Use of Natural Tree Growth.—Consideration should be given to leaving strips of trees when clearing land. It requires years to establish new belts at a considerable cost of labor and perhaps some loss of crops. It is desirable to leave these strips well back from roads to prevent excessive snow accumulation on the roads. Strips of trees over knolls and over tops of hills will result in the greatest benefit to crops. Where the growth is mostly poplar, brushing off without burning or plowing may be desirable. New growth in these strips may be utilized as farm woodlots. Good stands of evergreens (especially spruce) of varying sizes are found in some locations in north and north-central areas. In competition with poplars, willows and other trees these may require thinning.

Trees in roadside fence-lines that are in any way hazardous to traffic should be removed.

Tree Pests and Diseases.—For information covering these see page 98.

Publications on Tree Planting

Further information on the subject of trees and windbreaks may be obtained from publications as follows: (1) Tree Planting Near Dams and Dugouts. (2) Planning and Planting Field Shelterbelts. (3) Planting Trees and Hardwood Cuttings. (4) Varieties and Species of Trees for Farm Planting. (5) Renovation and Care of Established Shelterbelts. (6) Trees and Management Practices for Shelterbelts. (7) The Place of Poplar and Willow Shelterbelts. (8) Evergreens, Their Planting and Care in Farm Shelters. These publications are available from the Forestry Nursery Station, Indian Head, Sask.

VEGETABLE GARDENING[1]

Garden Site.—Important points in the choice of a garden site are: (1) avoidance of steep slopes because of losses resulting from run-off and erosion; (2) avoidance of sites subject to late frosts in spring and early frosts in late summer and early autumn; (3) presence of shelter on all four sides and (4) convenience to dwelling. Injury from frosts can be reduced frequently by placing the garden on an area that is somewhat higher than that adjoining, and thus providing better air drainage for the garden plot.

Preparation of the Soil.—An area twice the size required to produce the necessary vegetables in a given year should be set aside for the vegetable garden in most sections of this province. One-half of this should be summerfallowed each year and the other half cropped. An application of from twelve to fifteen tons of well-rotted manure to the acre should be made previous to summerfallowing. Where moisture conditions are favorable, summerfallowing may not be necessary. In such cases working in a light application of rotted manure in the fall is recommended. Fall cultivation of the garden area is important in preparing a good seed bed. Smoothing and packing are then the only spring operations required.

Use of Chemical Fertilizers.—Most

[1]For detailed information on vegetable gardening see University of Saskatchewan Extension Bulletin No. 95.

vegetable plants respond favorably to applications of chemical fertilizers even when barnyard manure has been used. Such fertilizers carrying moderate amounts of nitrogen and phosphates are desirable. Ammonium Phosphate (16-20-0) is satisfactory under most conditions.

Chemical fertilizers must not come in direct contact with the seeds.—A recommended method of application is that of placing the fertilizer in drills at each side of the row about two inches from and slightly lower than the seeds. A suitable rate of application is one pound to 100 feet of row. Where the soil is deficient in moisture an irrigation following seeding will benefit germination and dissolve the fertilizer.

Disease and Insect Control.—The use of timely control measures is essential. For information concerning these see pages 106 and 117.

Importance of Good Seed.—Seed of high quality is of utmost importance. Seeds carried over from previous years should be given a germination test before being used. The use of Certified seed is recommended. Seed treatments are often beneficial.

Seed Treatments.—Protection against damping-off and control of certain seed-borne diseases may be attained by seed treatment. Semesan and Arasan, or Captan compounds such as Orthocide are recommended. **Caution should be used to avoid over-treatment.** The directions on the container should be followed closely.

Seeding.—Celery, leeks, onions, peppers and egg-plants should be started indoors about April 1st, and tomatoes, broccoli, early cabbages and early cauliflower about April 15th. Plants should be grown short and sturdy, rather than tall and spindly. Plants of broccoli, leeks, cabbage, cauliflower and onions may be set in the garden before the end of May, but those of celery, egg-plants, peppers and tomatoes should not be set until all danger of frost is over unless plant protectors are used. If they must be used, tall tomato plants should be set in a sloping position at a normal depth with much of the stem length covered with soil.

Seeds of carrot, beet, radish, parsnip, spinach, chard, cauliflower and cabbage for the main crop, lettuce, parsley, onions and peas should be planted outdoors as soon as the ground is dry enough to work in the spring. Beans, corn, cucumbers, marrow, pumpkin, squash, melons and a second lot each of beets and carrots should be planted outdoors between May 15 and May 25 in most districts. The third planting of beets and carrots and the main planting of Swede turnips should be made early in June.

Where moisture is deficient the use of irrigation following seeding and transplanting is desirable.

Asparagus may be started from seed sown early in the spring in a row at one side of the garden and the seedlings transplanted to a permanent row one year later. A quicker method of obtaining a bearing plantation is to purchase one- or two-year-old plants, male plants preferably, and to plant these in the permanent location. Plants should be spaced about eighteen to twenty-four inches apart in the row with the crowns at a depth of three to four inches below the ground level.

Planting Rhubarb.—Rhubarb should be started from divisions, each having two strong buds or more. Planting in the spring is desirable. The plants should be set four feet apart in the row with the crowns about two inches below the ground level.

Spacing for Vegetables.—Rows of most vegetables should be at least three feet apart and the plants should stand well apart in the row. Wider spacings of the rows might be employed to advantage where moisture is scare and where power equipment is employed. Vegetables such as pumpkin, squash, marrow and cucumbers should be planted in rows spaced eight to twelve feet apart. Regardless of the spacing used, practise frequent shallow cultivation to destroy weeds. Planting close to trees should be avoided. Sow only enough seed to ensure the required stand of plants. Early thinning should not be neglected.

Storage of Vegetables.—Vegetables suitable for storage are those that have been well grown, that are free from insect injuries and diseases which are likely to give rise to trouble in storage, and that have been carefully and correctly harvested. Most vegetables should be stored at a temperature not more than a few degrees above freezing, in a well ventilated, reasonably moist atmosphere, with sufficient space to allow a free circulation of air. For squashes and pumpkins a temperature around 50° F. with a dry atmosphere is desirable.

Crops such as carrots, beets, parsnips and turnips are often dug and placed in storage much too early. If these vegetables are to remain in good condition in

storage it is important that they be left in the ground as long as possible, and dug only before there is danger of their being damaged by severe frost.

Plans for basement storage rooms may be obtained from your Agricultural Representative or Experimental Farm.

Home Preservation of Fruits and Vegetables.—Publications on these subjects that are readily available are: (1) Extension Bulletin No. 143 "Freezing Food at Home" (2) Canadian Department of Agriculture Publication 892 "Freezing Foods" (3) Canadian Department of Agriculture Publication 789 "Home Canning of Fruits and Vegetables" and (4) Canadian Department of Agriculture Publication 992 "Jams, Jellies and Pickles." These are available from Extension Department, University of Saskatchewan, Saskatoon, Sask.

Varieties of Vegetables.—It is important to use recommended varieties of vegetables. Varieties recommended are as follows:

PERENNIALS	
Asparagus	Mary Washington, Martha Washington.
Rhubarb	Macdonald, Sunrise, Canada Red.
Onion	Egyptian, White Welch, Chives.
ANNUALS	
Bean: Wax-podded	Round Pod Kidney Wax, Pencil Pod Black Wax.
Green-podded	Stringless Green Pod, Top Crop.
Beet	Detroit Dark Red.
Broccoli	Italian Green Sprouting, Purple Cape, Waltham 29.
Cabbage: Early	Canadian Acre, Early Jersey Wakefield, Golden Acre.
Main Crop	Danish Ballhead, Penn State.
Carrot	Selected Strains of Chantenay, Imperator, Scarlet Nantes.
Cauliflower	Early Dwarf Erfurt, Early Snowball.
Celery: Early	Golden Plume.
Main Crop	Cornell No. 19, Utah (Salt Lake).
Citron	Red Seeded.
Corn: Early	Banting, Dorinny, Early Golden Sweet, Golden Midget.
Mid-Season to Late	McFayden J-6 Cross, Seneca 60, Spancross, Golden Beauty.
Cucumber: Table	Cubit, Straight Eight.
Pickling	Early Russian, Green Thumb, Mincu.
Kohl Rabi	Early White Vienna.
Leeks	Champion and Giant Carentan.
Lettuce: Leaf	Salad Bowl, Simpson's Early Curled, Slobolt.
Heading	Continuity, Great Lakes, Iceberg, New York No. 12.
Marrow	Black Zucchini, White Bush.
Melon: Musk	Far North.
Water	Early Canada, New Hamsphire Midget.
Onion: For Greens	Dutch Sets, Multipliers.
For Bulbs: Red	Early Flat Red, Red Wethersfield.
Yellow	Early Grano, Yellow Globe Danvers.
Transplants	Ailsa Craig, Autumn Brown, Giant Yellow Prizetaker.
Picklers	Early White Barletta, White Portugal.
Parsley	Champion Moss Curled.
Parsnip	Hollow Crown, Short Thick.
Peas: Early	Little Marvel.
Mid-Season	Director, Lincoln, Selkirk.
Late	Stratagem, Telephone.
Peppers: Sweet	Harris Earliest, King of the North, Vinedale.
Hot	Hamilton Market.
Potato: Early: White	Warba.
Pink	Bliss Triumph, Waseca.
Main Crop: White	Irish Cobbler.
Pink	Early Ohio, Pontiac.
Russet	Netted Gem and Columbia Russet—somewhat late but often do well under irrigation or where the natural moisture supply is good.
Late Blight Resistant	Kennebec, and Cherokee—to be grown in areas where Late Blight is serious.
Pumpkin	Early Cheyenne Bush, Sugar.
Radish: Round	Champion, Cherry Belle, Comet, Saxa.
Long	Icicle.
Spinach	King of Denmark, Long Standing Bloomsdale, New Zealand.
Squash: Summer	Crookneck.
Winter	Buttercup, Golden Hubbard, Perfection, Uconn.
Swiss Chard	Lucullus.
Tomato: Non-Staking, Large fruited	Standard—Bounty, Early Chatham, Meteor, Bush Beefsteak. Hybrid—Monarch, Mustang.
Turnip: Garden	Strap-Leafed Purple Top, White Milan.
Swede	Laurentian.

THE POTATO

Sources of Seed.—The best seed obtainable should be used for planting purposes. Only Government Certified seed may be sold for such purposes according to law and the two classes provided for are Certified Foundation and Certified. The former complies with a higher standard of quality than the

latter. Information on the production of Certified seed potatoes and a list of growers can be obtained from the District Inspector, Seed Potato Certification Office, Box 819, Post Office Building, Estevan, Saskatchewan.

Home Seed Production.—It is good practice to begin with Certified seed of a desirable variety and to maintain a well isolated seed plot. This seed plot should be inspected frequently during the growing season, removing all plants showing deformed or otherwise abnormal tops on each inspection, and the product of the healthy plants used as seed the following year. **Where it is impracticable to maintain a special seed plot, growers are advised to purchase Certified seed at least every two or three years. Table potatoes should not be purchased for use as seed.**

Only sound tubers should be used for seed. Where seed that is not Certified is to be used, tubers of good size, that are typical of the variety and that show strong sprouts should be selected for planting. Tunnels in the tubers made by wireworms do not render them unfit for seed purposes.

Eyes.—Commercial eyes are cut from Certified seed. They are much less satisfactory than ordinary potato sets, however, and should be used only where Certified tubers are unobtainable. Owing to the small size of the seed piece, eyes should be carefully handled.

Seed Treatment.—Only limited success may be expected in the control of disease by seed treatment. Potato disease organisms that are externally borne on the tubers and which are destroyed by seed treatment are usually present in the soil also. Even so, seed treatment may be well worth while. For information on seed treatment write to Canada Agricultural Research Station, University of Saskatchewan, Saskatoon, Sask.

Preparation of Seed.—Seed potatoes should be transferred from their cool storage to a moderately warm room three to four weeks before planting time.

For early potatoes, the grower may place a number of medium-size whole tubers in a shallow tray, seed-end up, near a window, but not in direct sunlight a few weeks before planting time. These tubers will produce short, thick, green sprouts.

Tubers for the main crop may be cut into sets for planting or may be planted whole. It is common practice to plant the smaller potatoes whole and to cut the larger potatoes into one and one-half to two-ounce sets. Each set should have from two to three eyes. Any tuber with spindly sprouts or showing internal discoloration should be discarded. After cutting such a tuber, the blade of the knife used should be dipped in a solution of formalin at a strength of two teaspoonfuls of standard formalin in a quart of water or in a five percent solution of lysol (three teaspoonfuls in a cup of water). Cut sets are best planted soon after cutting. Sets not to be planted at once should be spread out in a single layer and no two cut surfaces should be in contact even for a short time.

The Potato Area and its Preparation.—Avoid growing potatoes in the same area oftener than once in five or six years. An area in which the soil is naturally moist but which has good surface drainage and good air drainage is desirable. When the crop is to be planted on a slope, the rows should cross the slope. Summerfallowing, following a moderate application of well rotted manure, is desirable.

Planting.—Planting is normally done between May 10 and May 20 depending upon the district and the season. Under average conditions the depth of planting should be about four inches. In heavy soils the planting might be a little shallower and in light soils it might be slightly deeper. The sets may be spaced twelve inches apart in the row where irrigation is to be practised or where moisture conditions are very favorable, but up to eighteen inch spacings may be used where moisture is less abundant. Rows in the farm garden should be at least three feet apart to allow room for cultivation and to avoid crowding.

Culture.—Cultivation should be shallow and should be completed by the time the plants have reached full bloom. Light hilling has virtue in protecting the tubers near the surface against greening and from frost injury.

Harvesting and Storage.—Harvesting should be done when the skin is well set but should not be delayed beyond the end of September in most years. Skinning or "feathering" of immature potatoes can be reduced by allowing the tubers to dry for an hour or two, not longer, before picking. Undue mechanical injury to tubers should be avoided. Where possible, potatoes should be kept at 65° to 70° F. for one or two weeks before going into winter storage at 36° to 40° F. This allows for healing of cuts and bruises, and will materially lessen storage-rots. The storage should be well ventilated during the fall months. Light

should be excluded to avoid greening of tubers.

Potato bins should be disinfected by spraying with one of the following: a formalin solution at a strength of one pint of the chemical to twenty-five gallons of water; a quarternary ammonium compound, one pint in twenty-five gallons of water; a solution of two pounds of bluestone in ten gallons of water.

Insect Pests and Diseases.—The potato is subject to attacks by many pests and diseases. Information on the control of these may be found on pages 117 and 106.

COMMERCIAL VEGETABLE PRODUCTION AND MARKETING

Farmers considering raising vegetable crops on a commercial basis are advised to (1) make a thorough investigation of the markets available. (2) obtain a picture of the annual fluctuations in prices. (3) realize that marketing fresh vegetables is highly competitive. (4) remember that the surest way to obtain sales is by offering only high quality vegetables to purchasers. (5) obtain storage facilities which have sufficient capacity to hold harvested vegetables and in which the vegetables can be maintained in a satisfactory selling condition. Storage may be necessary unless sales are made directly to a processor. (6) plan the vegetable enterprise on such a scale that it will adequately pay the costs of operation, the depreciation charges, the principal and interest on borrowed funds, a return on capital investment and a return for labor and management. (7) keep accurate accounts of the enterprise from the day it is started. (8) consider the choice of crop to be grown in relation to market demand, environmental conditions and personal choice. (9) study the choice of variety within the crop in relation to public acceptance, yield and quality. (10) enquire into cultural practices, fertility and irrigation as related to the particular crop, and into the mechanization of its production.

Any farmer considering commercial vegetable growing is urged to study the factors involved and to seek all the available advice from extension and research specialists in the University of Saskatchewan, the Saskatchewan Department of Agriculture, and the Canada Agriculture Research Branch, Experimental Farms.

FRUIT GROWING[1]

Varieties—Choice of variety in fruits is even more important than it is in vegetables. The need for extra hardiness, for marked tolerance to a limited supply of moisture and for early maturity places the choice of variety in fruits next to shelter in importance. Without proper guidance growers have in many cases made the mistake of choosing varieties unsuited to their conditions. Information on varieties in fruits is contained in the sub-section below.

Zoning Fruits

The Prairie Provinces have been zoned with regard to suitability of fruit varieties. The map shown is the Saskatchewan section of the larger map. Detailed information on fruit growing is lacking for Zones 6A and 6C. Certain special areas will be found within each zone. However, the variety ratings given in the table are for the zones as a whole.

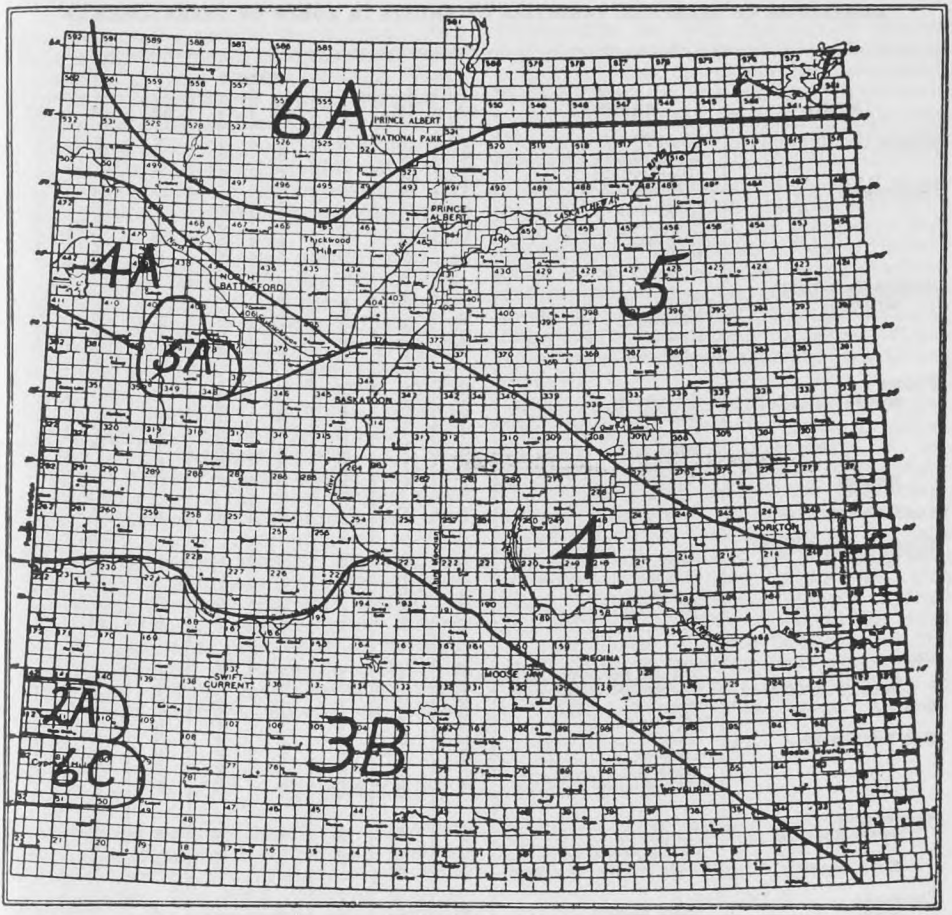
Site for Fruits.—A site similar to that outlined in section on vegetables is desirable. A very gentle slope toward the east or north is considered the best. Shelter is of prime importance and this should be provided on all sides.

Important.—All named varieties of apples, crabapples, plums and cherries are, for all practical purposes, self-unfruitful. **Plants of two varieties at least of the same kind of fruit are necessary for fruitfulness, and three or four varieties are preferable.** The hybrid plums listed are not sufficiently interfertile among themselves to be grown successfully alone but are interfertile with the other plums listed.

Propagation of Fruits.—The beginner is cautioned against starting with anything other than **named varieties** and these are not to be confused with **seedlings of named varieties.** Named varieties of our common hardy fruits do not come true to variety from seed. Increase in named varieties of fruits must be made through budding, grafting, and layering, and the use of cuttings, runners and suckers.

Number of Plants Required.—To supply a family of average size on a farm with abundance of fruit, plants might be required as follows: crabapples, plums and plum x sand cherry hybrids, one each of three or four varieties; red raspberries, fifty to one hundred plants;

[1]For detailed information on fruit growing see University of Saskatchewan Extension Bulletin No. 123.



Fruit Variety Zones

strawberries, fifty to one hundred plants; black currants and gooseberries, four to six plants of each. Varieties of the same kinds of fruits should be planted near one another to provide favorable conditions for cross-pollination.

Spacings.—The spacings recommended for average conditions are as follows: crabapples and plums, sixteen to twenty feet; plum x sand cherry hybrids, ten to twelve feet; red raspberry, rows eight feet apart; currants and gooseberries, rows six feet apart; strawberry, rows four to five feet apart. Where tractor cultivation is to be used or where the moisture supply is likely to be low wider spacings may be necessary.

Plants.—Strong, healthy plants are desirable. In tree fruits, plants either one year old or two years old are recommended. Older trees, when of normal size for the age, are more difficult to transplant than younger trees and the mortality resulting is likely to be greater with older trees than with younger trees.

Planting.—For all excepting the strawberry, planting in early spring when plants are dormant is desirable. The setting out of strawberry plants can frequently be delayed to advantage until some growth has been made. The roots of fruit plants must not be allowed to dry out during handling and planting. The soil should be firmed around the roots of newly set plants and a watering given after planting. A slight depression left around the base of the plant is advantageous.

Pruning.—Plants of crabapples, plums and cherries should be cut back to with-

BEHAVIOUR OF SELECTED VARIETIES OF FRUITS IN ZONES OF SASKATCHEWAN

KIND	VARIETY	ZONES							
		2A	3B	4	4A	5	5A	6A	6C
Apples	Brooks 27	T	T	T	T	T	T	T	T
	Heyer No. 12	S	S	S	F	S	S	T	T
	Heyer No. 20	T	S	T	T	T	T	T	T
Crabapples	Columbia	S	S	S	S	S	S	U	U
	Dolgo	S	S	S	S	S	S	T	T
	Florence	S	S	S	F	S	S	T	T
	Osman	S	S	S	S	S	S	S	T
	Robin	S	S	S	S	S	S	T	T
Crabapple x Apple Hybrids	Kerr	T	T	S	T	T	T	T	T
	Renown	F	S	S	T	S	T	U	U
	Rescue	S	S	S	S	S	S	T	T
	Trail	F	S	F	F	S	T	T	T
Plums									
Native	Assiniboine	S	F	S	S	S	F	T	T
	Bounty	S	F	S	S	T	F	T	T
	Dandy	S	F	S	S	S	T	T	T
	Mina	S	F	S	S	F	T	T	T
	Norther	S	F	S	S	S	F	F	F
Hybrid	Pembina	T	F	F	F	F	U	T	T
Sand-Cherry	Brooks	T	F	S	F	S	F	T	T
Sand-Cherry x Plum Hybrids	Dura	S	S	S	F	F	F	T	T
	Manor	S	F	S	F	F	T	T	T
	Opata	S	S	S	S	F	S	T	T
	Tom Thumb	F	F	F	S	S	F	T	T
	Heaver	T	T	T	T	T	S	T	T
Cherry									
Nanking	Selected Seedlings	T	T	T	T	S	S	T	T
Sour (P. fruticosa)	Selected Seedlings	T	T	T	T	S	T	T	T
Grapes	*Beta	T	T	T	T	T	U	T	T
	*Hungarian	T	T	T	T	T	U	T	T
Red Raspberry	Chief	S	S	S	S	S	S	S	T
	*Latham	S	S	S	F	F	F	T	T
	Muskoka	S	T	S	F	S	F	T	T
	*Viking	S	S	S	F	S	F	T	T
Strawberry									
June-Bearing	*Dunlap	S	S	S	S	S	S	T	T
	*Glenmore	S	—	S	—	S	—	T	T
Ever-Bearing	*Gem	S	S	S	S	S	S	T	T
Currants									
Red	Fay's Prolific	S	S	S	S	S	S	T	T
	Perfection	S	S	S	S	S	S	T	T
	Stephens	S	S	S	S	S	S	T	T
White	White Grape	S	S	S	S	S	S	T	T
Black	Climax	S	S	S	S	S	S	T	T
	Kerry	S	S	S	S	S	S	S	T
	Magnus	S	S	S	S	S	S	T	T
	Willoughby	S	S	S	S	S	S	S	T
Missouri	Selections	S	S	S	S	S	S	T	T
Gooseberry	Pixwell	S	S	S	S	S	S	S	T
	Thoreson (Pembina Pride)	S	S	S	S	S	S	S	T

* = Requires Winter Covering. S = Satisfactory. T = For Trial Only.
F = Fair. U = Unsatisfactory. — = Information Lacking.

in twelve to fifteen inches of the ground level immediately after being planted. One year later, branches produced from the stub should be thinned to five. These should be uniformly distributed over this stub and should be cut back to one-third their length.

Plants of currants and gooseberries should be cut back to within three or four inches of the ground at planting time and those of the red raspberry cut back to twelve to eighteen inches of the ground level. Raspberry, currant and gooseberry plants must be pruned correctly, annually, if good crops of fruit are to be obtained.

Winter Protection.—Canes of the less hardy varieties of the red raspberry should be bent over and covered with soil shortly before freeze-up. Plants of

the strawberry should be mulched with slough-hay or clean coarse straw soon after the ground becomes frozen. Vines of named varieties of the grape should be covered with soil late in the autumn.

The soil covering raspberry canes and grape vines and the mulch covering strawberries should be removed in the spring before appreciable growth takes place.

Protection of Fruit Plants Against Rabbits and Mice.—Fencing the plantation with a rabbit-proof fence offers an effective protection against rabbits provided (a) the fence is kept in good repair, (b) snowdrifts are not allowed to cover the fence and (c) rabbits on the inside are destroyed. Trapping, snaring, poisoning and shooting assist greatly in reducing the numbers of rabbits.

The short-tailed field mouse frequently becomes one of the most serious pests around gardens and orchards. The mice may work under cover of snow or during the growing season. Cleaning up grassy or weedy headlands and poisoning offer the best general control of this pest. Gopher poison mixed according to directions and placed in tin cans under a forkful of straw or a sheaf of oats has given good results. These poison-bait stations should be placed twenty-five to fifty feet apart around the outside of the plantation. It is also important that the poison be replenished before freeze-up and heavy falls of snow occur. All rodents tend to migrate and one should be on guard against their sudden appearance in serious numbers.

Repellents have not been tested widely in Western Canada. Such agents have been tested, however, in Montana, Wyoming and North Dakota where reasonably good results have been obtained. Information regarding recommendations made in these States may be obtained from the Department of Horticulture, University of Saskatchewan, Saskatoon, Sask.

Honeybees and Fruit Growing.—Honeybees are an asset in fruit growing. Cross-pollination is necessary if the plants of certain fruits are to be fruitful. While other insects are instrumental in making the necessary transfer of pollen, the honeybee is one of the best carriers of pollen and its presence does much to insure proper pollination. One good colony of bees is ample for a fruit plantation two acres in extent. If there is a shortage of honeybees in the district, farmers growing fruit should give serious consideration to the keeping of a colony or two of bees.

ORNAMENTAL GARDENING

Some attention should be given to the beautification of the home grounds beyond that of planting trees primarily for shelter. Beautiful grounds are uplifting to the community and a joy to possess, and they should be regarded as an essential part of the home of a progressive farmer.

The home grounds should be laid out according to a definite plan that embodies both utility and beauty. Provision should be made in the plan for a lawn area and for the use of ornamental shrubs, flowers and specimen trees. Over ambitious plans should be avoided. A simple plan which fits into the natural landscape is recommended. It is essential that the grounds be maintained in good condition. A small area well kept is preferable to a larger area partially neglected.

Only hardy, drought-resistant, and tried planting material should be used. Certain native shrubs can often be used to advantage. Both annual flowers and perennial flowers are recommended. In annuals, those that can be started outdoors are more desirable for use on the farm in most cases than those that require starting indoors. However, when established, many of the latter may have a longer season of bloom.

ANNUALS

A short list of dependable annual flowers that can be grown successfully from seed sown out of doors is as follows:

Lower-Growing

Bartonia, California Poppy, Candytuft, Clarkia, Dwarf Nasturtium, French Marigold, Godetia, Love-in-a-Mist, Mignonette, Phacelia, Portulaca, Scarlet Flax, Sweet Alyssum, Virginia Stocks.

Taller-Growing

Annual Baby's Breath (Gypsophila elegans), Black-eyed Susan, Chinese Houndstongue (Cynoglossum amabile), Corn Flower, Cosmos, Larkspur, Lavatera, Lupine (annual), Pin-cushion Flower (Scabiosa), Prince's Feather (amaranthus), Shirley Poppy, Sweet Sultan, Zinnia.

Climbers

Canary Nasturtium, Common Nasturtium, Morning Glory, Scarlet Runner Bean, Sweet Pea.

A few outstanding annuals and others treated as annuals grown from seed usually sown indoors late in March and which are obtainable in considerable variety are: Dianthus, Pansies, Petunias, Phlox, Snapdragons, Stocks, Sweet Scented Tobacco, Verbena.

Tender perennials grown as annuals and that have outstanding merit are: The Gladiolus and Dwarf Early-Flowering Dahlias.

Gardeners are warned about the danger of obtaining noxious weed seeds in "Wild Flower Garden" mixtures.

PERENNIALS

A short list of dependable hardy herbaceous perennial flowers is as follows:

Lower-Growing

Basket of Gold (Alyssum saxatile), Carpathian Harebell, Coral Lily, Dwarf Iris, Grass Pink, Haage Campion (Lychnis Haageana), Iceland Poppy, Maiden Pink, Moss Pink, Rock Cress, Rock Saponaria, Snow-in-Summer, Sweet William, Thunberg's Lily, Tulips.

Taller-Growing

Baby's Breath, Chimney Bellflower, Columbine, Day Lilies, Delphinium, German Iris, Golden Glow, Golden Marguerite, Jacob's Ladder, Lanceleaf Thermopsis (Thermopsis lanceolata), Lilies —Candlestick, Coral, David, Korean, Tiger and the hardy named hybrids— Lythrum selections, Peonies, Pyrethrum, Scarlet Lychnis, Siberian Iris, Spike Speedwell, Sweet Rocket.

All can be propagated by seed excepting named Irises, named Peonies, the Day Lilies, most of the Lilies, Tulips, Golden Glow, Lythrum and Moss Pink, which are usually propagated by division.

SHRUBS

A list of dependable hardy ornamental flowering shrubs is as follows.

Low-Growing to Medium Height
(up to four feet in height)

Dwarf Euonymus, European Cotoneaster, Oriental Spirea, Peking Cotoneaster, Pikow Spirea, Pigmy Caragana, Redosier Dogwood, Russian Almond, Roses—Dr. Merkeley, George Will, Stanwell's perpetual, Therese Bugnet — Shrubby Cinquefoil, Sweetberry Honeysuckle, Threelobe Spirea.

Taller-Growing

American Mountain Ash, Amur Maple, Buffaloberry, Cherry Prinsepsia, Chokecherry, French Lilacs, Highbush Cranberry (or Pembina), Hungarian Lilac (S. josikaea), Hybrid Lilacs, Korean Lilac (S. dilatata), Lorberg's Caragana, Manchurian Honeysuckle, Missouri Currant, Pincherry, Roses— Betty Bland, Hansa, Harison's Yellow, Persian Yellow, Scotch, Tetonkaha, Wasagaming—hardy varieties of Rosybloom Crabapples, Russian Caragana, Salt Tree (grafted on caragana), Saskatoon, Sutherland Caragana, Tatarian Honeysuckle, Tatarian Maple, Wild Plums.

Woody Climbers

Chinese Clematis, Manitoba Wild Grape, Virginia Creeper, Western Virgin's Bower (Native Clematis).

HEDGE PLANTS

Low to Medium

Peking Cotoneaster, Pigmy Caragana, Shrubby Cinquefoil, Sweetberry Honeysuckle.

Medium to Tall

Amur Maple, Common Caragana, hardy strains of Manchu Elm, Hungarian Lilac, Late Lilac, White Spruce.

TREES

A short list of desirable trees for use as ornamentals is as follows: (a) **Evergreen**—Colorado Spruce, Scotch Pine, Swiss Stone Pine, White Spruce. (b) **Deciduous**—American Elm, Bur Oak, Green Ash, Manchurian Elm, Siberian Larch, Weeping Birch.

Further Information on Ornamentals. —This may be found in (a) Extension Bulletin No. 127, "A List of Flowers, Shrubs, Vines and Trees," available from the Extension Department, University of Saskatchewan, (b) Department Pamphlet "Planning and Planting the Home Grounds," issued by and available from Department of Horticulture, University of Saskatchewan, Saskatoon, Sask. (c) A series of Department Pamphlets on the culture of various flowers indoors and outdoors issued by and available from Department of Horticulture, University of Saskatchewan, Saskatoon, Sask. (d) "Farmstead Planning in Saskatchewan" available from Department of Agriculture, Regina, Sask.

LAWN MAKING

Important grasses for use in making lawns in this Province are Kentucky Bluegrass, Chewing's Fescue, Creeping Red Fescue, Fairway Strain of Crested Wheatgrass and Russian Wild Ryegrass, Kentucky Bluegrass and Chewing's Fes-

cue are capable of making excellent turfs but they have limited drought resistance and are recommended for use only where artificial watering can be given or where rainfall is reasonably abundant. Crested Wheatgrass and Russian Wild Ryegrass do not make closely knit turfs but have great drought resistance and are recommended for use under dry conditions. Marion Bluegrass has done well in some sections of the province but it cannot be given an unqualified recommendation. Kentucky Bluegrass should be seeded at the rate of one pound of seed to 150-200 square feet and Chewing's Fescue, Creeping Red Fescue, Fairway Strain of Crested Wheatgrass and Russian Wild Ryegrass at the rate of one pound to one hundred square feet. The seeding rates recommended are based on the use of good seed. New-crop seed is desirable in the fescues as this seed often deteriorates rapidly. The best time for seeding in most sections of the province is during the latter part of May or early in June. Setting during the hot dry months should be avoided where artificial watering cannot be practised. On small areas the seed can be raked in with a garden rake. On large areas the seed can be sown with a seed-drill. **Where watering can be practised the surface soil should be kept moist after seeding until the grass appears.**

Fertilizing the Lawn.—Where artificial waterings can be given, an application of Ammonium Phosphate (16-20-0) at the rate of one pound to 150 square feet or Ammonium Nitrate Phosphate (27-14-0) at the rate of one pound to 250 square feet of lawn surface soon after growth begins in the spring usually gives good results. The fertilizer should be broadcast evenly when the grass is dry and followed by a watering. A second application may be used early in July. Where artificial waterings can not be given an application of fertilizer shortly before winter sets in or early in the spring is recommended.

Dandelion Control in Lawns.—Dandelions can be controlled in most lawns through the use of 2,4-D. The safest forms for use on lawns and near flowers, shubs and trees are the amine, and esters of low volatility. These should be used according to directions on the container and great care should be exercised to confine the spray to the area being treated. Most flowers, vegetables, shrubs and trees are sensitive to the chemical, and drifting spray reaching them may do serious damage. Application should be made on a calm day to minimize drift. The solution may be applied as a spray at low pressure and under full control or it may be applied from a watering-can provided with a fine rose. The latter is preferable. Dandelions should be treated when actively growing and when the leaf surface is dry. At least a few hours should elapse between treatment and the occurrence of rain or the use of a sprinkler on the area. Atmospheric shade temperatures of 65° F. or over at the time of application are desirable. Treated dandelion plants may be cut even with the ground surface four days after the treatment is given, without decreasing the kill.

Where possible, application should be made early in the season before most plants in the garden have made much growth and before flower and vegetable plants started indoors have been planted out. Equipment used in appplying this chemical should NOT be used either in watering or in spraying other cultivated plants.

Additional Information on Lawns.—Anyone wishing further information on lawn making might consult "Seeding and Care of Lawns in Saskatchewan" available from Department of Agriculture, Regina, Sask., and "Let Us Have a Good Lawn" available from Department of Horticulture, University of Saskatchewan, Saskatoon, Sask.

IRRIGATING THE FARM GARDEN

The subject of irrigation is covered in a special section in this publication. Where further information on the subject is desired the reader is referred to the bulletin "Irrigating the Prairie Home Garden," a copy of which may be obtained from your nearest Experimental Farm.

SOIL TESTS

In many cases the failure of garden plants and trees to thrive in a given area is traceable to some undesirable soil condition. This condition may be physical or chemical. Samples of such soil may be submitted to the Department of Soils, University of Saskatchewan, Saskatoon, Sask., for examination and for a test. This service is given free. Directions for taking soil samples will be found in the section on "Soils and Fertilizers."

FARM FORESTRY

Thousands of farmers in the forest-fringe area of Saskatchewan are in a wonderful position to help themselves, help industry and help the province by properly managing their woodlots. According to a recent survey by the Forest Inventory Division of the Department of Natural Resources, 2,900,000 acres of forest land in north-central Saskatchewan is privately owned. Not only that, but many more acres of presently submarginal land for agriculture could profitably be planted with trees to provide valuable wood material for the future.

A woodlot is like money invested, with annual growth representing earned interest. Like interest, it can be allowed to accumulate for several years before being harvested.

With proper management a woodlot can provide a variety of wood products either for use on the farm or for sale. It provides profitable employment during slack periods or in times of poor crops as well as utilizing land unsuited to farming. It is, therefore, an important part of the whole farm enterprise.

Apart from their direct and material benefits woodlots provide protection of the soil against wind and water erosion; maintenance of a relatively constant water table; shelter for crops and livestock; cover for beneficial bird and animal life; protection to roads and buildings; beautification of the environment.

Types of Woodlot

There are three main types of woodlots in Saskatchewan—the pure, even-aged kind (typified by pine, poplar and black spruce stands); the mixed, uneven-aged kind (typified by the white spruce-balsam fir-poplar stands); and the cull kind (consisting of stunted aspen and black poplar). Each poses its own management problem, information on which may be obtained from the Extension Forestry Service, Department of Natural Resources, Prince Albert, Sask.

Woodlot Protection

Before a woodlot can be managed effectively, certain initial steps must be taken to protect it from the ravages of fire, grazing, insects and disease. Fire destroys young plants and damages the larger trees even though it may not kill them. Recommended protection measures are: (1) keep freshly ploughed fire-guards around the woodlot so that grass fires cannot run into it. (2) keep the woodlot clear of windfalls and dead trees. (3) divide the woodlot with logging roads which can be used as internal fire-guards.

Woodlots should be fenced to keep out livestock. Grazing by livestock destroys the small trees, compacts the soil and damages the root systems of larger trees.

Marketing

Farm needs for lumber, posts and fuel generally offer the best market for the products of farm woodlots. While commercial opportunities are limited in the province, they do exist in certain localities from time to time for such products as Christmas trees, fuelwood, fence-rails, fence-posts, box logs, pulpwood, poles, piling, plywood-bolts and lumber.

When entering the commercial market, the farmer should study that market very carefully. He should consider what to sell, where to sell, when to sell, and how to sell. He should talk to two or more possible purchasers for any product before cutting the material. Two useful marketing pointers are: (1) sell products in as finished a form as possible. For instance, when stumpage (standing timber) is worth $6.00 per thousand board feet, rough lumber may be worth $50.00 per thousand. (2) where possible, sell on a measured log basis and not on a stumpage basis.

Tree Planting

Idle acreage may be put to work by planting it to trees. Trees for this purpose are obtainable at the nominal cost of one cent each from the Extension Forestry Service, Department of Natural Resources, Prince Albert, Sask.

Assistance Available

On-the-spot technical guidance on all phases of woodlot work, as well as reference literature and a speaker and film service, are available free of charge on application to the Extension Forestry Service, Department of Natural Resources, Provincial Government Building, Prince Albert, Sask.

Tree Pests and Diseases

For information covering these the reader is referred to pages 119 and 98.

WEED CONTROL

Weeds are often the greatest source of loss on the farm. They rob crops of moisture, increase production costs, and decrease land values. In addition, weeds provide favourable habitats for many injurious insects. In Saskatchewan moisture conservation is important. The most important requirement in moisture conservation is weed control.

GENERAL RECOMMENDATIONS

1. Sow clean seed. Stationary seed cleaning plants should be used wherever possible. Farm cleaning is usually preferable to elevator cleaning.

2. Watch for unknown weeds and have them identified. Send specimens preferably when in flower and including part of the root system, to your Agricultural Representative, to the nearest Experimental Farm, the University, or to the Department of Agriculture, Regina.

3. Use forage crops. Grasses or grass-legume mixtures help in the fight against weeds. Ask your Agricultural Representative about the Forage Crop Program.

4. Control weeds on uncultivated land. Fence lines, stack bottoms, slough margins, road allowances and barnyards may produce vast quantities of weed seeds which will spread to nearby land. Seed these areas to suitable grasses or treat with recommended chemicals.

5 Encourage community effort. The individual can clean up his farm but unless his neighbours do likewise he will be faced with new infestations. Rural municipalities may appoint Weed Inspectors to assist in weed control and to enforce provisions of the Noxious Weeds Act.

6. Do not spread weeds by:
   (a) Tillage and harvesting equipment.
   (b) Livestock movement.
   (c) Hauling grain, hay and screenings.
   (d) Spreading unrotted manure.
   (e) Growing unknown ornamental plants.
   (f) Moving infested soil.

7. Do a good job of summerfallowing. Make proper use of shallow tillage.

8. Spray grain crops with herbicides every year.

HOW WEEDS ARE GROUPED FOR CONTROL RECOMMENDATIONS

Annuals.—For control purposes they are divided into two groups:

(a) Annuals—these weeds grow from seed in the spring or summer, produce seed, and die in the same growing season (e.g. wild oats, Russian thistle, wild buckwheat).

(b) Winter Annuals—weeds that start growth in the fall, live over winter and produce seed the following year. Many in this group also grow as annuals (e.g. stinkweed).

Biennials.—These weeds need two seasons to produce seed. They germinate and begin growth one year, start from roots the following spring, produce seed the second year and die (e.g. biennial wormwood).

Perennials.—Weeds which live more than two years and reproduce from both seed and roots. The roots lie dormant over the winter and new top growth starts each spring (e.g. Canada thistle, couch grass, toadflax).

CONTROL OF ANNUAL, WINTER ANNUAL, AND BIENNIAL WEEDS

Control these weeds by reducing the number of seeds in the soil and preventing further infestations by proper seeding practices, the use of competitive crops, good summerfallowing and the use of chemicals.

I. Seeding Practices

1. Destroy as many weeds as possible before seeding by methods such as:
   (a) Early spring tillage to start weed growth.
   (b) Tillage of new growth immediately before seeding or with the seeding operation.
   (c) Delay seeding and till to kill a crop of weeds.

2. Reduce weed competition by establishing sturdy, even stands of grain.
   (a) Seed into moist soil at a uniform depth. Depth of seeding should not exceed the depth of first tillage or weed seeds may be brought up to germinate with the crop.
   (b) Packing after seeding, or seeding with a press drill, will often hasten germination.
   (c) Sow sound, clean seed. Seedlings of high vitality can compete better with weeds. If poorer seed must be used increase the seeding rate.

(d) Fertilizers, in districts where they are recommended, will stimulate growth and make the crop more competitive.

(e) If a heavy infestation of weeds is expected, increase the seeding rate 25% to 35% to increase competition.

3. Shallow after seeding tillage, either with the rod weeder or harrows, will give good control of weeds if weed seeds have germinated before the crop has sprouts more than one-half inch long. Where harrows are used, warm dry days are essential for rapid weed kills.

II. Competitive Crops

(a) Barley and rye offer more competition to weed growth than other grain crops. Flax competes poorly with weeds.

(b) Cropping systems which include seeding part of the farm to legumes or grass-legume mixtures will aid in control of weeds. Shallow breaking following these crops will avoid bringing up deeply buried weed seeds.

III. Summerfallow Practices

(a) Germination of some weeds (e.g. wild oats) may be encouraged by shallow fall tillage. Use fall tillage of stubble when there are annual weeds which may ripen before freeze up, or when there is a growth of winter annual or biennial weeds.

(b) In the spring, tillage for fallow should start as soon as weed growth appears. Tillage should be thorough, but not of such a nature as to encourage soil erosion.

(c) Where soil erosion is a problem, spraying may be substituted for one or two tillage operations. Where winter annual weeds are present, fall spraying of fallow should be done in place of tillage.

(d) Fallow, after an early crop of hay has been removed, may give satisfactory weed control.

IV. Chemicals—(See Chemical Section)

CONTROL OF SPECIFIC ANNUAL WEEDS

WILD OATS

Cultural Control

Delayed Seeding—This is the best method of controlling wild oats. The surface should be tilled to a depth of not more than four inches early in the spring to aerate the soil and promote germination of the wild oat seed. Delay seeding until there is a maximum of growth of wild oats. In most localities seeding can be delayed until the first week in June if necessary. Pre-seeding tillage to kill wild oats should be done in dry hot weather, if possible, and care must be taken to avoid going below four inches, otherwise fresh wild oat seed will be brought up to further infest the crop. If the soil is moist, seeding should be as shallow as possible. Flax should not be seeded on wild oat infested land except where chemical control is to be used. An early maturing barley is the most suitable crop for delayed seeding and should be seeded at a slightly heavier rate than is normal. An application of a recommended fertilizer will help to ensure best possible results. Delayed seeding of at least two crops is usually necessary for good results.

Post-seeding Cultivation—Rod weeders, cable weeders or harrows can each be used to advantage to destroy wild oat plants after the crop has been seeded. Seeding should be done a little deeper than normal. Cultivation should begin when the sprout on the grain crop is one-half inch long. To be effective, the surface soil must be dry and the weather bright and warm.

Fall Cultivation—Shallow tillage of stubble to cover wild oat seeds is a good practice in heavily infested fields. The cultivation should be done in late September or early October for best results. The primary aim is to provide a seedbed for wild oats which will promote rapid germination in the spring.

Cropping Methods—(a) Green feed crops or infested areas should be cut for forage prior to heading of wild oats. Wild oats headed when cut will mature and seeds will be spread in feeding. Infested areas should be tilled to prevent seed production. (b) Fall seeded crops, such as fall rye, can be used to advantage. (c) Forage Crops—Grasses and legumes left down for some years will do much to lessen the incidence of wild oats.

Chemical Control

The chemical, 2-3-dichloroallyl diisopropylthiocarbamate (Avadex) may be used for the control of wild oats in flax as a pre-planting application. Apply 2 pounds per acre in 10 gallons of water

just before seeding but only if it can be thoroughly incorporated (mixed) in the soil. The chemical should be incorporated the same day to a depth of 3 inches using a disc type implement. Seeding with a disc type implement will serve to incorporate the chemical. On stubble, a double operation is necessary for good incorporation.

Green Foxtail (Wild Millet, Pigeon Grass)—Several practices will help to control this weed: (a) good seed bed preparation, (b) harrowing after seeding, (c) very early spring tillage of land to be summerfallowed, (d) clean, shallow summerfallowing.

TCA at 4 to 6 pounds or Dalapon at 12 to 20 ounces per acre can be used to kill green foxtail in flax or rapeseed, but should not be used in cereal grains. Apply before the foxtail has developed four leaves, preferably when flax is 4 to 6 inches tall. Rape should be sprayed in the 2 to 4 leaf stage. The lower rates may be used on light soils. At least ten gallons of water per acre should be used for application.

MCPA or 2,4-D may be mixed with TCA or dalapon to control weeds in flax by one spray operation.

Wild Buckwheat—Delay seeding to permit germination of as much buckwheat as possible. Allow a crop of weeds to start in the spring. Cultivate them out and wait ten days to allow a second crop to start. Kill this crop of weeds and seed immediately. Harrowing or rod weeding after seeding will give some control.

Good chemical control of wild buckwheat is obtained with a double application. As soon as the wild buckwheat has reached the first or second true leaf stage, treat with 4 to 5 ounces of 2,4-D ester or 5 ounces of MCPA ester per acre regardless of the stage of crop. Wait seven days and treat again at the same rates. If the crop has not reached the three-leaf stage, the very early treatment with 2,4-D may damage it slightly. However, being cleaner it will usually produce a higher net yield. MCPA can be used at the earlier stage with less damage to the crop. For oats use MCPA for both applications.

Tartary Buckwheat—Tillage and cropping practices used for other annual weeds apply also to tartary buckwheat. Do not till infested land in the fall unless conditions are warm and dry. For chemical control in wheat and barley, treat with 6 to 8 ounces of 2,4-D ester per acre as soon as crop growth permits. MCPA at 12 to 16 ounces per acre is better for oats and flax. These rates will reduce growth and seed set but will not eradicate the weed.

CONTROL OF PERENNIAL WEEDS

In the seedling stage perennials can be controlled the same as annuals. After they become established, control measures must be undertaken to deplete the root reserves. This can be achieved best by intensive tillage.

Intensive tillage means tillage done often enough to prevent regrowth from appearing for more than a week. If the area is large, precautions against soil drifting should be taken.

Perennials have underground "buds." If portions of the underground parts are cut off and scattered they are capable of starting new patches. Patches should therefore be cultivated separately to avoid spread. Chemicals may also be used for the control of perennial weeds.

CONTROL OF SPECIFIC PERENNIAL WEEDS

Couch Grass (Quack Grass, Twitch Grass)—Cultivation is the only feasible means of controlling field scale infestations of couch grass. Start in late autumn just before freeze-up using deep plowing, spiking and/or one-way discing. Intensive tillage as outlined previously should be carried on throughout the following season. If the infested area is large and subject to erosion, it is advisable to strip crop the field. Disc implements are recommended because they cut sod better and are less likely to drag underground parts to uninfested areas.

Small patches can be eradicated with chemicals. TCA at 3 to 4 ounces or Dalapon at 2 to 2½ ounces per 100 square feet applied in one quart of water are recommended on undisturbed sod. If the sod is tilled before application, a rate of 2 to 2½ ounces of TCA or 1 ounce of Dalapon per 100 square feet is usually sufficient. Cultivation two to three weeks later may be necessary for a complete kill. Better results can be obtained with Dalapon by making two applications of ½ ounce per 100 square feet, the first before tillage and the second when resprouts are 3 to 4

inches tall. The effect of the chemical in the soil may extend into the next growing season.

Sodium chlorate compounds will eradicate couch grass, but the soil may remain sterile for two or more years. They are more effective if used in the fall. One to 2 pounds per 100 square feet should be applied.

Monuron (C.M.U.) may be used on non-crop land. Apply in early spring or late fall at ¾ to 1½ ounces per 100 square feet. The lower rates may be used under warm, moist conditions.

Canada Thistle and Perennial Sow Thistle—These weeds may be controlled by the following methods:

(a) After harvest treatment with 2,4-D ester at rates of 24 to 32 ounces per acre in combination with tillage just before freeze-up. If this is followed by a full season of intensive tillage, eradication should be almost complete. An application of 2,4-D at 24 to 32 ounces per acre may be substituted for part of the tillage during this period.

Where minimum tillage is desired during the summerfallow year, thistles may be left undisturbed until they have reached the bud stage, at which time 24 to 32 ounces of 2,4-D ester per acre should be applied. Further regrowth may be sprayed at 16 to 24 ounces per acre. This should be followed by a thorough tillage just prior to freeze up.

(b) In crops, top growth can be controlled and seed setting prevented by spraying with 2,4-D or MCPA at the maximum rates recommended for the crop. Esters of 2,4-DB or MCPB at 16 ounces per acre can be used in cereals or seedling alfalfa, but the former is more effective. The amine and sodium salts of MCPB are safer for flax and peas.

(c) Seeding down to a strongly competing grass. Treating with 2,4-D will greatly weaken the plants and aid the grass in becoming established. This practice is more applicable to slough edges, roadsides and other uncultivated land.

(d) On non-crop land, esters of 2,4-D in repeated dosages of 16 to 32 ounces per acre will control these weeds. Best results are obtained if the first application is applied at the bud stage. Soil sterilants, such as (a) sodium chlorate at 1½ to 2 pounds (b) chlorate-borate compounds at 2 to 3 pounds (c) Monuron (CMU) at 2 ounces per 100 square feet will kill these weeds, but costs limit their use to small patches.

Toadflax, Leafy Spurge, Hoary Cress, Russian Knapweed, Bladder Campion and Field Bindweed.

(a) On good crop land a two-crop system, involving intensive tillage of fallow, has reduced the stand of these weeds enough to permit successful crop production during the following year. Tillage with a disc-type implement to cut off seedlings and sprouts in the fall is very important.

(b) Top growth of leafy spurge, hoary cress, and field bindweed can be controlled in grain crops with 2,4-D ester at 6 to 8 ounces per acre.

(c) Seeding the land to grass after it has been intensively fallowed and then spraying every year with 32 ounces of 2,4-D ester per acre reduces the stand and vigour of these weeds.

(d) Treat small scattered patches with soil sterilants in the fall. Use chlorate compounds (such as Atlacide or Polybor Chlorate) at 3½ pounds, monuron (CMU) at 2 to 3 ounces, borate compounds (such as Concentrated Borascu) at 3 to 4 pounds, or borate-2,4-D compounds (such as D Bor granular) at 2 to 3 pounds per 100 square feet. On sandy soils, borate compounds will eliminate toadflax at 1 to 2 pounds per 100 square feet and borate-2,4-D compounds at 1½ to 2 pounds per 100 square feet will eliminate leafy spurge. Monuron is not effective on leafy spurge nor are borate and borate-2,4-D compounds on hoary cress. Take care to treat the patch, including a six-foot margin around it. The treated area should not be tilled for at least two years. If regrowth appears, the area should be retreated. Seedlings may be killed by tillage or with 2,4-D at 12 ounces per acre.

Dandelion—Tillage should start immediately after harvest and continue throughout the next season, until freeze-up. Each cultivation should be deep enough to cut the plants below the crown. A tillage operation may be substituted by an application of 2,4-D at 2

pounds per acre. On non-crop land, applications of 2,4-D at 4 pounds should be made whenever top growth appears. In grain crops, the top growth can be checked with 2,4-D at 10 to 12 ounces per acre.

CHEMICAL WEED CONTROL

Control of Weeds in Grain Crops

Grain crops and flax should be treated with chemicals every year. Early treatment results in highest yield increases. In addition young weeds are easier to kill.

Wheat and Barley

The ester of 2,4-D has proved the most satisfactory for wheat and barley. These crops should be treated as soon as they have reached the three-leaf stage, but are tolerant to 2,4-D until the shot-blade stage. Earlier treatment is sometimes necessary.

Oats

MCPA is recommended at all growth stages, but should be applied as soon as weed growth warrants. If weeds resistant to MCPA are present (e.g. Russian thistle or sow thistle), the 2,4-D amine may be used during the period from emergence to the two-leaf stage or between the six-leaf and shot-blade stages. Considerable damage to oats frequently occurs if 2,4-D is used, particularly the ester formulation.

Flax

Flax is more tolerant of MCPA and 2,4-D amine than of 2,4-D ester. Where sow thistle or Russian thistle are present, 2,4-D should be used but some flax damage may be expected. Flax should be treated when the plants are 2 inches high and should not be treated after buds appear.

For the control of green foxtail, wild oats, Canada thistle and sow thistle in flax refer to above discussions under these weeds.

Winter Wheat and Fall Rye

Use rates recommended for the control of annual and winter annual weeds. Treat in the spring from the time the crop starts growth until the shot-blade stage. MCPA should be used for fall treatments until the crop reaches the three-leaf stage, after which 2,4-D may be used.

Rate of Chemical for Grain Crops

The rate will be determined by:

(a) Stage of weed growth—annual and biennial plants are most susceptible when young. Perennials are generally less susceptible than annuals and chemicals are more successful if applied at the early bud or very early bloom stage.

(b) Kind of weed—there is a wide variation in the susceptibility of weeds to chemicals (see weed classification table).

(c) Growing conditions—under cool or dry conditions chemicals should be used, but higher rates are necessary.

Recommended rate of 2,4-D and MCPA for spraying weeds in grain crops are as follows:

OUNCES ACID EQUIVALENT PER ACRE

Crop	Formulation	Weed Group I	Weed Group II	Weed Group III	Weed Group IV	Weed Group V
	2,4-D					
Wheat, Barley and Rye	Ester	3-4	4-6	6-8	(9-12)	(12-16)
	Amine	4-5	5-7	7-9	(10-14)	(15-20)
Oats (in special cases)	Amine	(4-5)	(5-7	(7-9)		
Flax	Ester	3-4	4-6	(6-8)		
	Amine	4-5	5-7	(7-9)		
	MCPA					
Oats, Wheat, Barley and Rye	Ester	3-4	4-6	6-8	(912)	(12-16)
	Amine	4-5	5-7	7-9	(10-14	(15-20)
Flax	Sodium Salt	5-6	6-8	8-10	(11-15)	(15-20)
	Ester	3-4	4-6	(6-8)	(9-12)	
	Amine	4-5	5-7	(7-9)	(10-14)	
	Sodium Salt	5-6	6-8	(8-10)	(12-15)	

Note:

(a) The above rates are for sprays. For dusts, increase rates by one-third.

(b) The higher rates are recommended for cold or dry conditions, for weeds in advanced stages of growth, for weeds classified in groups III to V and for crops heavily infested with weeds. The rates in brackets may cause some crop injury but this will frequently be offset by fewer weeds and a higher net yield.

(c) All rates refer to acid equivalent per acre. Each gallon of chemical

contains a stated acid equivalent of 2,4-D (64 oz., 80 oz., 128 oz.). The remainder of the gallon is an emulsifier or carrier. In applying the chemical one must consider only the acid equivalent of 2,4-D per acre. For example, a gallon with 64 ounces of acid equivalent will do 16 acres at 4 oz. acid equivalent per acre.

CONTROL OF WEEDS IN FORAGE CROPS, PASTURES, RANGES AND LAWNS

Alfalfa and Clovers (except sweetclover)

Newly seeded stands can be treated early with 2,4-D or MCPA amine at 3 to 4 ounces per acre or MCPA sodium salt at 3 to 6 ounces per acre.

Seedling stands (2 to 4 inches high) of alfalfa, red, white and alsike clovers may be treated with 2,4-D amine or MCPA at 4 to 5 ounces per acre. 2,4-DB at 16 to 24 ounces per acre in 20 gallons of water may also be used. Red, white and alsike clovers may be treated with 16 ounces of MCPB per acre in 20 gallons of water. Ester formulations of 2,4-D or MCPA should not be used in legumes.

Sweet Clover

Where seedling stands of sweet clover are excessively weedy, they may be treated with MCPA at 4 to 5 ounces per acre. Sweet clover should not be treated with 2,4-D except where it is being grown with a companion crop for green manure purposes. It is very susceptible to 2,4-D just before and shortly after flowering, and the seed yield may be greatly reduced by 2,4-D drift.

Crested Wheat and Brome Grasses

New seedings which have made four inches of growth may be treated with 2,4-D ester at rates up to 16 ounces per acre. Fields for seed production should be treated as early as possible but not after the early shot-blade stage. Perennial weeds in stands of grass should be treated with 2,4-D ester at 16 to 24 ounces per acre immediately after harvest.

Pasture Weeds

2,4-D ester at 1 to 2 pounds per acre can be used for the control of certain weeds in native grass pastures, waste land or cultivated pastures which do not contain legumes. Treatment in successive years may be necessary (see weed classification table).

Lawns

New lawns may be sprayed after they nave been mowed twice. Established lawns may be sprayed anytime, preferably in late May. To control dandelions and most broadleaved weeds in established lawns, use 2,4-D amine or low volatile ester at 32 ounces of acid equivalent per acre. For each 1,000 square feet of lawn, use 3 tablespoons of chemical containing 80 ounces acid equivalent per gallon or 4 tablespoons of chemical containing 64 ounces of acid equivalent per gallon. Care must be taken to prevent drift from reaching susceptible plants. Use a watering can or a coarse spray.

Potatoes

Four ounces of 2,4-D ester per acre can be applied before the potatoes have emerged, or about two weeks after seeding. The chemicals and rates used on flax can be used on potatoes when they are in the 4 to 6 leaf stage.

Horticultural Crops

Special recommendations for the control of weeds in horticultural crops are available upon request.

Control of Weeds on Uncultivated Lands, Fencelines and Barnyards

Soil sterilants are effective for complete removal of all growth, to prevent the spread of a troublesome weed, or to provide a bare area for implement storage. Chlorate compounds, Monuron or Borate-Monuron compounds will effectively denude small areas of vegetation if used as specified on the labels. Granular forms of these chemicals are available. These compounds should not be used near trees. Avoid the use of sodium chlorate around buildings because of fire hazard. The use of these chemicals should also be avoided where they could seep into waters that may later be used for domestic or irrigation purposes.

Warnings Regarding the Use of Chemicals

Misuse of chemicals may cause considerable damage. **HEED THE PRECAUTIONS ON THE LABELS OF CHEMICAL CONTAINERS.**

Spraying equipment should not be used to spray susceptible plants with insecticides without a thorough cleaning. Wash equipment with a soap solution, then fill and flush with a solution of household ammonia at the ratio of one quart to 25 gallons of water.

WEED CLASSIFICATION ACCORDING TO RESPONSE TO 2,4-D AND MCPA

Group I—Very susceptible.

Wild Mustard

Group II—Susceptible annuals—requiring higher dosages than Group I.

Lamb's quarters	Tumbling Mustard	False Ragweed
Ball Mustard	Wormseed Mustard	Great Ragweed
Hare's Ear Mustard	Common Ragweed	Stinkweed
Indian Mustard		Sunflowers

Group III—Moderately susceptible—susceptible in early growth stages. May become less susceptible under adverse conditions and/or with advancing growth.

Blue Bur	Flixweed	Stinging Nettle
Burdocks	Goatsbeard	Russian Pigweed
Sweetclover	Gumweed	Common Plantain
Cocklebur	Prickly Lettuce	Wild Radish
Dandelion (in lawns)		Shepherd's Purse

Group IV—Moderately resistant—Under adverse conditions and/or with advancing growth become highly resistant. Perennials will require retreatment.

Prostrate Amaranth	Dandelion (in fields)	Annual Sowthistle
Field Bindweed	Curled Dock	Perennial Sowthistle
Hedge Bindweed	Western False Flax	(Gr. V for MCPA)
Peppergrass	Large-Seeded False Flax	Canada Thistle
Red-root Pigweed	Spear-leaved Goosefoot	Prairie Thistle
Pineapple Weed	Common Groundsel	Russian Thistle
Wild Buckwheat	Dog Mustard	(Gr. V for MCPA)
Tartary Buckwheat	Purslane	Tumbleweed
Tall Buttercup	Quickweed (Galinsoga)	Biennial Wormwood
Common Chickweed	Smartweeds	Blue Lettuce
Hoary Cress		Tansy Mustard

Group V—Consists mainly of perennial weeds of which generally only the top growth is controlled with 2,4-D or MCPA.

Creeping Buttercup	Horsetail (Group IV	Leafy Spurge
(Group IV for MCPA)	for MCPA)	Hemp Nettle (Group
Russian Knapweed	Scentless Chamomile	IV for MCPA)
	(Resistant to MCPA)	

Resistant—Resistant to 2,4-D and MCPA: control impossible or impractical with these chemicals (except in pastures where heavy rates may be used).

Bladder Campion	Shrubby Cinquefoil	Grasses
Bracken Fern	Cow Cockle	Tansy
Cacti	Purple Cockle	Yellow Toadflax
Night-flowering	Knotweed	Milkweed
Catchfly	Wild Licorice	Poverty Weed
White Cockle	Stinking Mayweed	Pasture Sage
Corn Spurrey	Shield Cress	Yarrow
	Ox-eye Daisy	

CONTROL OF WOODY BRUSH

Only 2,4-D and 2,4,5-T are recommended for woody brush control. Special brush killing mixtures are generally a combination of these two.

There are three main methods of killing brush and trees with chemical.

(1) Foliage spraying—for best results spray as soon as the trees are fully leaved. 2,4-D is recommended except for resistant species, such as rose and raspberry (see classification Group III), in which case 2,4,5-T should be used. All foliage must be thoroughly wetted, using 2 to 4 pounds of acid equivalent per acre in 10 gallons of water. Retreatments are usually necessary.

(2) Over-all dormant spraying—this is done during the absence of foliage. A mixture of 2,4-D and 2,4,5-T should be used. Two to four pounds of the mixture should be applied in 10 to 15 gallons of diesel fuel per acre.

(3) Bark and stump treatment—for

bark treatment, apply from a height of two feet down to the ground line. When growth is tall, spraying may not produce good results and cutting followed by stump treatment becomes necessary. For stump treatment, cover the entire stump. In each case the bark at the ground line and protruding roots should be wetted to the point of runoff. A solution of 1½ pounds of acid equivalent of 2,4-D ester or mixtures of 2,4-D and 2,4,5-T in 10 gallons of oil is recommended.

WOODY PLANTS CLASSIFIED ACCORDING TO THEIR RESPONSE TO HERBICIDES

Group I—Susceptible to 2,4-D

Caragana	Manitoba Maple	Saskatoon	
Chokeberry	Lilac	Western Snowberry	
Currants	Pincherry	Spirea	
Hazelnut	Aspen Poplar	Willows	
Honeysuckle	Balsam Poplar		

Group II—Resistant to 2,4-D

Blackberry	Oak	Raspberry	Rose
Wolf Willow			

Group III—Apparently more susceptible to 2,4,5-T than 2,4-D

Ash	Bearberry	Blackberry	Dogwood
Hawthorn	Raspberry	Rose	

Where trade names of products are mentioned in this "Guide" they are to be considered as examples and their mention does not necessarily constitute a recommendation.

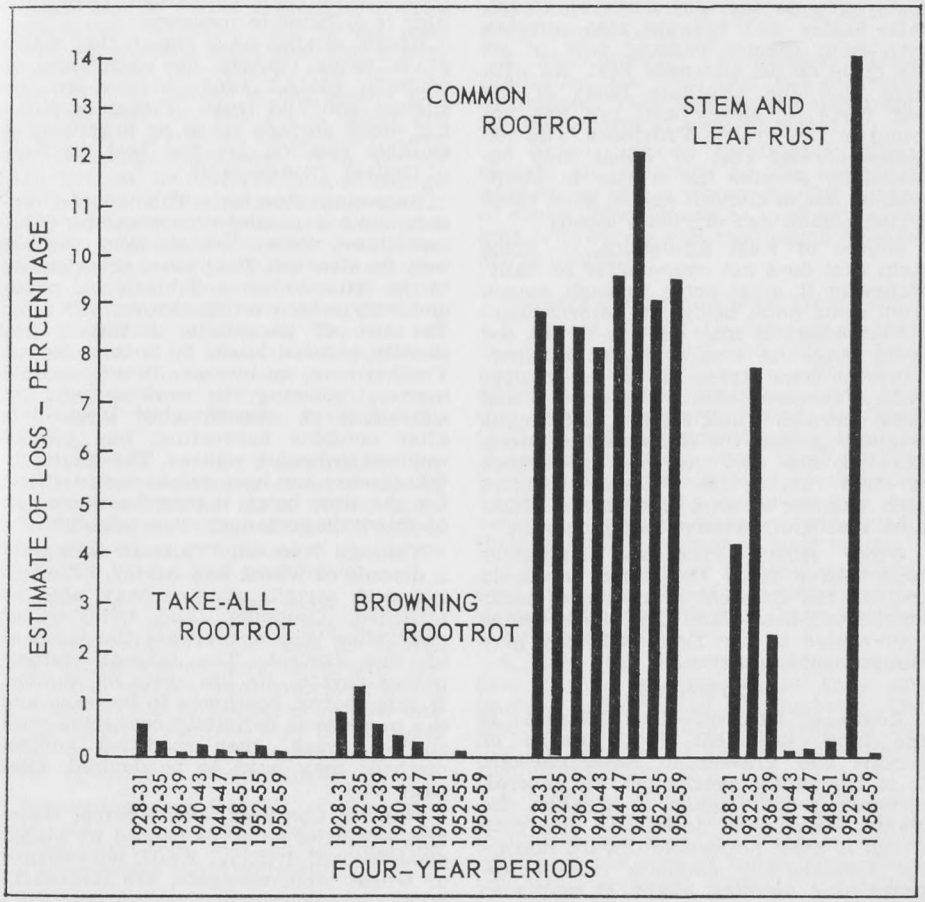
PLANT DISEASES

FIELD AND GARDEN CROPS

RUSTS

Cereal rusts found in Saskatchewan are the stem rusts and leaf rusts of wheat, oats, barley and rye. The best means of controlling rust is to grow resistant varieties, but varieties which are resistant to one race of rust may not be resistant to another. Moreover, the stem rust fungus consists of several units which may attack one or more cereals and certain grasses, and each of these units is made up of physiologic races which differ in their ability to attack cereal varieties. The appearance of new races of the rust fungus may be expected from time to time.

Spread of Rust by Spores.—There are several spore stages in the rust fungi, which have complex life cycles. Successive generations of the red summer spores are produced every 10 to 14 days and cause new infections. Under



A graphic comparison of losses in wheat in Saskatchewan caused by three root diseases and rusts. Each bar represents the average loss over a four-year period. Take-all, which was important in the park belt, is now held in check by good farm practices, including summerfallow; it could become serious in wet years with a change in cropping methods. Browning rootrot, once a serious disease in central Saskatchewan, has just about disappeared with the use of phosphate fertilizers and the practice of returning crop trash back to the soil. Common rootrot, though variable from year to year, is still a factor in wheat production. The losses from rusts are related to host resistance, though influenced by rainfall. Note the low loss records from about 1940 to 1952, when Thatcher wheat was resistant to the prevalent forms of stem rust.

favourable conditions the rust soon increases to epidemic proportions. The red spores of rust rarely survive the winter in Saskatchewan. Late in the season, however, all cereal rusts produce black spores on straw and leaves and these spores can over-winter.

Alternate Host Plants.—The black winter spores cannot infect grain or grass plants but must find an alternate host plant. In the case of the stem rust fungus the alternate host is the common barberry and as there are no susceptible barberry bushes in Saskatchewan the life cycle of the fungus cannot be completed here.

The life histories of most other cereal rusts such as the leaf rusts of wheat, oats, barley and rye are also complex with each species passing part of its life cycle on an alternate host. As with stem rust the alternate hosts of the leaf rusts of barley and rye are not found in the Prairie Provinces. The red spores of leaf rust of wheat may occasionally survive the winter in Manitoba or Saskatchewan and in such cases a rust attack can originate locally.

Source of Rust Epidemics. — Since stem rust does not over-winter in Saskatchewan it must come in each season from some point below the international border where it may survive in the red spore stage on winter wheat. Furthermore, in some areas of the Mississippi Valley, barberry shrubs are present and these serve as a host for the rust fungus originating from the black winter spores. This explains why the first appearance of stem rust in the Prairie Provinces each summer occurs in southern Manitoba and southeastern Saskatchewan.

Other Rusts.—Flax and sunflower rusts differ from the cereal rusts in that all the different spore stages occur on the one host plant. The black spores over-winter in the field and may give rise to new infections.

ROOTROTS

Common Rootrot.—This disease is the most prevalent root disease of cereals and grasses in Saskatchewan. It is frequently overlooked. In general, common rootrot tends to weaken the plants, causing a decline in the crop which is most noticeable toward maturity. Occasionally common rootrot appears as a seedling blight. It may also appear as conspicuous dead plants in the green crop.

The infection may arise in the spring from contaminated seed, but much more frequently from spores in crop residues on the surface of the soil. The fungi causing common rootrot remain viable on and in the surface soil over winter. In late May or early June the first points of infection appear on parts of the seedlings near the soil surface. Spore production and reinfection in the crown zone of the plants continue through the growing season. Hence, severe lesions may develop in the crowns, crown roots, tiller buds and subcrown internodes.

Under warm weather conditions with limited soil moisture the disease advances in the underground parts of the plant, causing a decline and a sharp reduction in yield. Under good growing conditions on the other hand, the plant may have rather severe lesions without conspicuous yield reductions. Hence injury is difficult to measure.

Recent studies have shown that many grain fields contain an abundance of common rootrot fungi in and on the surface soil and trash. Therefore plowing down surface trash or practising a suitable rotation are the best methods of control. (See page 97.)

Browning Rootrot.—This rootrot occurs most commonly in wheat on summerfallow. Other cereals and grasses may be attacked. It appears occasionally in the dark brown and black soil zones and very seldom in the brown soil zone. The use of phosphatic fertilizers has greatly reduced losses from this disease. Furthermore, an increase in soil organic matter, following the working into the soil of large quantities of straw left after combine harvesting, has greatly reduced browning rootrot. The decline in this disease has been so phenomenal that for the time being it may be classed as of minor importance. (See page 93.)

Take-all Rootrot.—Take-all is mainly a disease of wheat and barley, although rye and certain grasses may also be attacked. Cropping land with wheat year after year encourages the increase of this rootrot. The take-all fungus passes part of its life cycle on stubble. If this rootrot continues to increase and the increase is definitely connected with surface trash, then modified control methods may have to be devised. (See page 97.)

Injuries Confused with Rootrot Damage.—Injuries to crops caused by alkali, drought, soil drifting, 2,4-D, wireworms, or wheat stem maggots, are frequently mistaken for rootrot damage, and conversely, rootrots may be mistaken for other troubles. Specimens may be submitted to a pathologist for examination.

SMUTS

Kinds of Smut.—The smuts of cereals commonly found in Saskatchewan may

be divided into two main types as follows:

1. **Smut carried on the Seed**
   Bunt or covered smut of wheat
   Covered smut of barley
   False loose smut of barley
   Covered smut of oats
   Loose smut of oats
2. **Smut carried in the Seed**
   Loose smut of wheat
   True loose smut of barley

Seed Examination.—Smuts overwinter either on or in the seed and they can be detected by seed examination. The centrifuge test is used to detect spores of smuts carried on the surface and the embryo test to detect mycelium of true loose smut in barley. All wheat seed should be given a smut test and a germination test. The embryo test for true loose smut of barley in Registered and Certified seed is done for a small fee by the Plant Products Laboratory, London Building, Saskatoon. The centrifuge test can be obtained free of charge through many local elevator agents. If no bunt is present in wheat seed samples and 90% or more of the seeds germinate, treatment is not likely to increase the yield. Barley and oats usually carry some smut, so regular treatment of these two cereals is advisable. The use of smut-free seed is of special importance in dealing with true loose smut of barley, because seed treatment for the prevention of this disease is relatively costly.

In addition to the examination for smuts, other seed-borne diseases can be detected by routine tests. When there is any doubt regarding the health status of a seed lot, a sample of it should be examined by a plant pathologist.

Taking a Sample for Seed Examination.—It is important to get a representative sample. Take ten or twelve small samples from various parts of the seed lot to make a total sample of about one half pound. Information on how and where to send samples may be obtained from agricultural representatives, elevator agents and other sources.

Prevention and Control of Smuts.—This may be accomplished either by sowing smut-free seed or by applying the appropriate seed treatment.

Treatment for Smuts Carried IN the Seed.—Loose smut of wheat and true loose smut of barley may be controlled by means of the hot-water treatment or the salt-water soak treatment. It is suggested that growers treat just sufficient seed each year to sow a few acres as a seed plot unless there is a community treating centre available (see Table, page 101.)

Treatment for Smuts Carried ON the Seed.—There are many different fungicides on the market at the present time. (For a list of the fungicides in each class and their rates of application see Table, page 101.) Those used for the control of surface-borne smuts come under the following headings:

1. Mercury dust: These are among the best fungicides in use at present, but they must be handled with care.

2. Liquid fungicides containing mercury: These fungicides equal the mercury dust in effectiveness and they eliminate the flying dust but still require care in handling.

3. Non-mercury fungicides: These fungicides are relatively non-poisonous to humans. **They are recommended only for the control of bunt of wheat.**

4. Dual purpose treatments: These contain an insectcide for the control of wireworms and mercury for the control of smuts. They should be used only when both wireworms and seed-borne diseases are a problem.

Pointers Concerning Seed Treatment

1. Wheat should be treated at least one day, and barley and oats at least one week before they are sown unless directions on the container state that this is not necessary. Sound, dry seed, treated with fungicides only, may be stored safely for a year. Dual purpose treatments may be applied at any time during the winter prior to seeding, but continued storage under warm conditions is likely to result in seed injury.

2. Seed grain may become contaminated if it is placed in containers or cleaned in machines that have handled a smutty seed-lot.

3. Even the best fungicides cannot give perfect control unless they are properly distributed throughout the seed. Efficient machines designed for this purpose should be used. (See Farm Equipment, page 38.)

4. Mercury fungicides are very poisonous to humans. Wear a dry mask and place the machine where a breeze will carry the dust or fumes away from you while treating. Brush your clothes and wash hands and face carefully after handling treated seed. Keep children and livestock away from treated grain. Seed cleaning plants should have a separate building for treating and storing treated seed. Repeated exposure to fungicidal dust or fumes may result in cumulative poisoning, therefore operators of

seed treating plants should avoid inhaling dust or fumes. It is unlawful to sell treated grain to commercial elevator companies.

ERGOT

Ergot is a disease of cereals and grasses. The black or purplish sclerotia appear in the heads when the seed is developing. Ergot is very common in rye, common in barley and grasses, occasionally found in wheat, but very rarely in oats. It does not attack rape, sunflower, or legumes, although other sclerotia found in seeds of these crops are sometimes mistaken for ergot. Ergot contains poisons. Any grain that contains as much as one-tenth of one per cent of ergot should not be used for feed (see Control, page 102).

SEED TROUBLES

Many disease-producing organisms, chiefly fungi and bacteria, are carried on or in seeds. The seeds of cereals will be considered here mainly because of the importance of cereal crops in Saskatchewan. Generally speaking the better classes of all seed offered for sale will be free of, or practically free of, serious seed-borne maladies. Some of the diseases of cereals which may be detected by pathologists through observation or laboratory testing are as follows: ergot, covered smuts, loose smuts, smudge, scab, and bacterial blackpoint. Moreover, there may be abnormalities such as piebald, frost injury, mechanical injuries, and various discolorations.

DISEASES OF GRASSES

Snow-mould is a soil-borne fungus disease which appears in the early spring when the snow is melting. The fungus attacks the crown tissues and plants may be killed outright or they may produce weak spindly shoots when growth begins. The disease may occur in small or large patches. All of the grasses are susceptible to the disease except brome and crested wheat.

Root and crown rots are caused by a group of soil fungi which usually produce a slow decay of the roots. Under poor conditions the plants gradually turn yellow and may die; when good conditions return, diseased plants may recover and resume growth. These diseases damage all species of grasses.

Seedling blight is caused by a complex of soil fungi which destroy seed and young seedlings. As a result, stands may be reduced seriously. There is very little genetic resistance to seedling blight.

Winter injury. Excessive cold or abnormal conditions such as icing or alternate freezing and thawing may kill grasses completely or leave them weak. Some species of grasses are hardier than others (see page 67, Forage Crops).

Ergot. Many tame and wild grasses are susceptible to ergot and when growing on roadsides, and headlands may serve as sources of infection for grain crops. Ergot bodies are poisonous to livestock.

Smuts. Several grass smuts are seed-borne and may attack stems, leaves or heads. Because of their perennial nature, grasses become infected permanently.

Grasses are susceptible also to rust, mildew, leaf spots, and viruses that damage the leaves, mostly, and reduce the forage value of the grasses. The fungi, etc., which cause these diseases overwinter on crop residues. There are differences in susceptibility among the various species of grasses.

DISEASES OF LEGUMES

Winter crown rot is caused by the same fungus which causes snow mould of grasses. Alfalfa and all of the clovers are susceptible. Plants are damaged late in the fall and early in the spring, resulting in thinning and weakening of the crop. The tops of the plants killed by this disease are easily broken at the soil line while the roots remain sound for considerable time.

Bacterial wilt affects alfalfa only. It causes a gradual blocking of the conductive tissues of the roots, which in turn causes wilting and abnormal growth. This disease can ruin a crop of alfalfa under irrigation in three to four years It is not important on dry land. Vernal alfalfa is highly resistant; other varieties range from slightly resistant to highly susceptible (see Forage Crops, page 56).

Seedling blight causes rotting of seed and death of young seedlings. The soil fungi which cause seedling blight do more damage under certain weather and soil conditions than others; for example, wet, cold soils favour infection. All species of legumes are susceptible.

Black stem and leaf spot diseases are caused by fungi which overwinter on crop residues. Spots are mostly brown and vary in size from pin-point to a quarter-inch in diameter. Heavy spotting usually causes defoliation which in turn results in serious losses of forage. Stems turn dark brown, and the small branches bearing flowers and pods may

be girdled and killed. There is very little genetic resistance to these diseases.

Wilt and basal rot is caused by a fungus which produces a woolly growth and frequently black sclerotia on and in the stems of alfalfa and clovers. This fungus also attacks rape and weeds belonging to the mustard and thistle families.

Deficiency diseases and viruses cause stunting, discoloration, and general unthriftiness. Application of recommended fertilizers will correct deficiencies. Many legume viruses have weeds as wild hosts; destruction of these weeds will assist in control.

DISEASES OF RAPE

The growing of rape as a cash crop has become a permanent feature in prairie agriculture. A knowledge of its chief diseases and their control is therefore essential.

Sclerotinia stem blight causes bleaching and sometimes premature death of plants. Affected plants pull easily, the stems are pale in color, and when slit open are found to contain black, hard, oval fungus bodies (sclerotia) near the base. These sclerotia fall to the ground or get mixed with the seed during threshing. They serve to carry the disease over winter. This disease occurs in sweet clover, sunflowers, and several weeds of the mustard and thistle families. Rotation with cereal crops, including a fallow year, and control of weeds will reduce infection.

The white rust-downy mildew disease complex distorts the inflorescences (flower parts) so that swollen, abnormal, often spiny, structures appear in place of the normal seed pods. At first, if conditions are moist, these abnormal structures may develop white powdery masses (spores) on their surfaces; later they turn brown and resistant spores are formed inside. Fragments are broken off at harvest, fall to the ground or get mixed with seed and serve to carry the disease over winter. Seed should be well cleaned and rape should not be sown after rape or adjacent to a field sown to rape the previous year. Rape should not be grown on land infested with mustard or thistles. The disease is troublesome in moist, northern areas.

The aster yellow virus attacks rape causing a bladder-like enlargement of the leaves. Percentage infection is usually low.

Black spots on stems and pods are caused by a moderately parasitic fungus (Alternaria). Discoloration of the plants and some shrivelling may occur. Crop rotation and the use of well-cleaned seed will help to reduce infection.

Little or no benefit is gained by treating seed of high germination, such as 90 per cent or higher; however, some improvement results by treating seed for 80 per cent germination or lower. Orthocide 75 (a Captan product), Ceresan M, and Agrox C at 1 oz. per 50 lb. of seed have given satisfactory results.

FLAX DISEASES

Rust and wilt, the two major flax diseases, are now adequately controlled by growing the recommended resistant varieties. In northern areas where earliness is important early maturing varieties should be selected.

Practically all flax diseases are seedborne and also overwinter on flax straw and stubble. It is therefore advisable to treat all flax seed with a fungicide. Various mercury fungicides and Orthocide 75 (a non-mercury Captan compound) at the rate of 1½ oz. per bushel of seed have proved satisfactory. They should be applied at least 24 hours before sowing. The crop should be planted on fallow land or on the stubble of any crop except flax. If sown adjacent to an old flax-stubble field, the diseased straw should be buried if this is possible before the new crop emerges.

The aster yellow virus disease may be damaging on flax in years when the grey leafhopper is plentiful. This insect transmits the virus from diseased weeds and other infested crop and garden plants. The leafhoppers may swarm in large numbers from further south or may arise locally. Helpful measures are early seeding, the adequate control of weeds in and around flax fields to remove local sources of infection, and locating the flax field as far away as possible from waste land.

Several of the flax diseases usually develop late on the maturing crop. If, therefore, sowing is done early, the crop is more likely to escape heavy infestations late in the season, with consequent higher yields of better quality seed.

TRASH COVER AND PLANT DISEASES

The practice of maintaining a trash cover to prevent soil erosion appears to favor certain plant diseases. During recent years there has been a noticeable increase in such leaf diseases as net blotch, and speckled leaf blotch in barley, and leaf blotch in wheat, and common rootrot in both wheat and barley.

The fungi causing these diseases were once kept down by burning the straw and plowing down the stubble in which they overwintered. With present recommendations to retain straw and stubble on the soil, control of the diseases mentioned above will depend more than ever on crop rotations. Thus diseased crops of wheat may be followed by oats, non-cereal crops, and, except for rootrot control, by barley. The moldboard plow, used with a pony drill in preparation and seeding of land, is proving useful in light soils by burying fungus-carrying trash, leaving the soil without a protective cover for only a few days before emergence of the new crop. This procedure makes rotation of crops less essential in such areas; however, rotation appears the best means available for control of leaf diseases of cereals.

Leaf and stem diseases of non-cereal crops, such as flax, rape, sunflowers and forage crops, overwinter in leaf and stem residues in the field. When such residues are maintained as trash covers, crop rotation becomes a very important control measure for the leaf and stem diseases. Rotation of these crops with cereals will reduce the likelihood of infection from crop residues. Perennial crops pose a special problem where rotation has limited application and such drastic measures as burning crop residues may be required for disease control.

VEGETABLE AND FRUIT DISEASES

Vegetable and fruit diseases may be carried in the soil or in diseased tissues and plant refuse. Some vegetable diseases are seed-borne. Weeds also may harbor certain diseases. It is important to main high fertility and good tilth of the soil by means of manure and other organic fertilizers. Plant refuse from diseased crops should be burned or turned under.

Seed Treatments.—Certain seed treatments are helpful in combating seed-borne parasites and soil organisms that attack the seed and young seedlings. Semesan, Arasan, and Spergon are dusts in general use; the first two are poisonous and care must be taken in handling them. Dusts may be applied by shaking the required amount in a bottle along with the seed, until it is thoroughly distributed. The amount of dust carried on the seed is sufficient. Excess dust may be removed by a fine screen.

Certified Seed and Propagation Stock.—Raspberry canes and potato tubers for planting purposes, certified by Canada Department of Agriculture inspectors to be relatively free from virus and other diseases, are available on the market. "Run-out" raspberries or potatoes should be replaced by healthy stocks. Certified disease-free seeds of peas and beans are now available.

Spread by Insects. — Many potato, vegetable, and fruit diseases are spread by insects. Some are spread only in this manner. Prevalence of such a disease is a reflection of the abundance of the insect carrier and control of the disease is dependent upon the control of the insect.

Storage Problems.—For a discussion of storage problems, see the section on "Horticulture," page 77.

TREE DISEASES AND WOOD ROTS

TREE DISEASES

The most common kinds of failure in prairie tree plantations undoubtedly result primarily from the unfavourable conditions in which the trees are required to grow. Prairie conditions, even at their best, are not very favourable for tree growth. Extreme winter cold, low moisture supply, and unfavourable soil are primarily responsible for most of the apparent disease. Trees in prairie regions frequently are dangerously near the limit of their ability to survive these severe conditions; therefore, any slight additional adversity is likely to result in unhealthy symptoms. Where die-back occurs, heavy pruning back of the dying branches and tops is the best treatment. Windbreak trees should not be expected to retain prime form and condition indefinitely. Under difficult growing conditions they naturally pass their prime and begin to decline at an early age. The most reliable means of protecting trees against disease is to give them the best of care in order to ensure a reserve of vigour. Vigorous trees have little difficulty in recovering from attacks of most kinds of diseases. It is seldom practicable or necessary to control tree diseases by means of sprays. (For information on spray control of mites and insects and of fruit tree diseases, see elsewhere in "Guide to Farm Practice.")

WOOD ROTS

Fungi, which cause decay, can not grow in wood that is either too dry or too wet, or in wood that contains preservative. Thus, wood in well-construct-

ed houses, and wood that is continuously submerged in water, lasts indefinitely without becoming decayed.

Ideal conditions for decay are provided when wood is kept moderately moist, in moderate temperature, where ventilation is poor. These conditions exist under basementless buildings if no ventilation is provided, and wherever wood is in contact with moist ground.

Whenever wood is to be used in moist places it should be treated with a preservative which is poisonous to fungi. This will protect it from decay for many years. Preservatives provide direct protection only to the wood that is penetrated by the preservative. A treated surface layer thus acts as a barrier which protects the inner untreated part of the wood from invasion by fungi from the outside. If an opening is made through this protective barrier, fungi may gain access to the untreated wood in the interior through this opening. If it is necessary to make cuts through the treated surface, or if shrinkage cracks occur after the wood is treated, these exposed surfaces should be swabbed generously with preservative.

Decay of Floors and Basement Timbers.—Decay (sometimes called "dry rot") of floors and basement timbers is caused by a fungus that comes from fragments of rotted wood in the ground, from partly rotted wood used in construction, or from air-borne spores which settle on the wood, and germinate if conditions are right. It thrives in moist, unventilated places.

It is much simpler to prevent dry rot than to get rid of it once it has attacked a building. Sills or other wooden parts should never be placed in contact with the ground, but only on stone or cement foundations or piers.

Under buildings without basements a space of not less than eight to twelve inches should be left above the ground, and large openings should be left in the foundation for ventilation. Completely covering the ground under such buildings with heavy asphalt roll roofing, greatly helps to prevent decay by preventing ground moisture from evaporating and causing a damp atmosphere. Partly rotten lumber or timbers should not be used under a building, but only sound, well seasoned wood. The under surface of floor boards, and all surfaces of joists, sills, and other wood parts beneath basementless buildings should be treated with preservative before they are fastened in place. A solution of six ounces of **sodium Fluoride** per gallon of water is recommended. This should be applied generously, and should be flooded into all cracks and crevices. At least two applications are recommended. When repairing rotted woodwork under buildings, all surfaces of the entire space (including soil) should be thoroughly saturated with this disinfectant.

It is useless to treat wood after it has begun to decay. The only remedy is to remove the affected boards and timbers, and replace with sound, well seasoned treated wood. If it is not possible to remove entire boards, joints, etc., when only partly rotted, the rotted parts may be cut out, but the cut must be made in perfectly sound wood at least a foot if possible beyond the last trace of decay. It is important to treat these surfaces thoroughly before making joins. All of the removed wood and all fragments and debris under repaired building should be removed and burned immediately.

Treating Fence Posts.—The life of fence posts may be increased many years by treatment with preservatives to prevent decay. This may be done simply and cheaply on any farm. Untreated posts usually rot at or below ground level while the tops remain relatively sound. Therefore it is most important to treat the butts up to about eight inches above the ground level. For added protection the tops may be given a light treatment, especially if the posts are of a highly non-durable species such as poplar. A steel oil drum with one end cut out makes a good tank for butt treatment. Spruce, pine, poplar, or other kinds of posts may be treated by the following methods.

(a) Treating dry posts.—For this method the posts must be peeled, well seasoned, and dry. It is important to remove the thin strips of inner bark that sometimes remain after peeling.

In the "cold soaking" butt treatment the dry posts are stood in a tank of unheated creosote for one or more days. For economy of cost, the creosote may be diluted with an equal part of diesel or fuel oil, or with a mixture of diesel or fuel oil with waste crankcase oil; but the more crankcase oil that is used, the less penetration into the wood there will be. The object is to get the deepest possible penetration. It is the creosote and not the oils, which preserves the wood from decay.

Better penetration is obtained if the creosote mixture is heated by setting the tank on a brick or stone fire-place. For convenience, this may be built into

an earth bank. Still better penetration is obtained if, after 4 hours or so in the hot mixture, the posts are transferred to a tank of cold mixture for a few hours, or they can be left in the hot mixture until cool. When removed from the tank the posts may be drained and the run-off mixture saved for re-use.

Other preservatives which may be used as above are: (1) **Penta** (pentachlorophenol) 5 per cent solution in diesel or fuel oil. (2) **Copper naphthenate,** 2 per cent copper in diesel or fuel oil. These materials are most conveniently obtainable from builders' supplies dealers in the form of ready-mixed preparations under various trade names.

(b) **Treating green posts.**—For this method the posts must be treated while fully green. They should be peeled immediately before treating, and if the ends have become dried out they should be trimmed off immediately before immersing. All precautions should be taken to have the wood as moist and fresh as possible at time of treating. The posts are then stood in a tank of unheated solution made with ½ pound of dry **chromated zinc chloride** or 1 pound of 50% commercial solution (obtainable from C.I.L.) per gallon of water. The soaking should continue for 3 or 4 days in warm weather or in a heated building. Chromated zinc chloride is now recommended in preference to bluestone. If bluestone is used it would be best to use pine posts.

ENQUIRIES

Enquiries concerning tree diseases and wood rots may be addressed to Forest Biology Laboratory, Canada Agriculture Research Station, University Sub Post Office, Saskatoon, Sask. Detailed description and history of the trouble should accompany all specimens. Leaf and twig specimens should be pressed flat between newspaper and cardboard.

Further details and publications concerning treatment of fence posts and decay of basement timbers may be obtained from the above or from the Forest Products Laboratory, Department of Northern Affairs and National Resources, Ottawa.

For information of woodlot management, write to Director of Forests, Department of Natural Resources, Prince Albert, Sask.

Materials for preservative treatments may be obtained (some under various trade names) through local dealers, from the manufacturers of coal tar products (creosote), chemicals, and paints.

THE MORE IMPORTANT CROP DISEASES

CEREALS AND GRASSES

Disease	Crop	Symptoms	Control
Stem rust	Wheat, Oats, Barley, Rye, Grasses	Dusty, raised, reddish brown oblong spots on leaves, stems and heads, becoming black as the plant matures. The red spore dust may adhere to hands, clothing or machinery.	Use resistant varieties as recommended. (See page 49). Early seeded crops and early maturing varieties tend to escape rust damage.
Leaf rust	Wheat, Barley, Rye	Dusty, yellow to light orange, small round to oval spots on leaves and sheaths, becoming black as the plant matures.	
Crown (leaf) rust	Oats	Dusty, orange to yellow oblong spots on leaves, sheaths and heads, becoming black as the plant matures.	Eradicate any nearby buckthorn shrubs (alternate host). Sow oats early to mature before epidemic becomes severe. Resistant varieties as recommended.
Bunt (covered or stinking smut)	Wheat	Bunt balls are produced in place of kernels; not conspicuous in the field. Best seen in threshed grain where brush end is darkened; unbroken bunt balls may be found in seed; usually an unpleasant odor is present.	Use resistant varieties where suitable. (See page 49). Use smut-free seed if available. If seed carries smut spores, then treatment should be applied. The following fungicides are on the market: **Mercury dusts:** Agrox C, Canuck Organic Mercury, Co-op Organic Mercury, Ceresan M, Half-ounce Leytosan, Puraseed and San. All of these are applied to cereals at the rate of ½ oz. per bushel. **Liquid fungicides containing mercury:** Canuck Liquid Mercury, Ceresan 75, Ceresan 100, Co-op Liquid Mercury, Gallotox, Mer-sol, Panogen 15 and Setrete. Most of these are applied to cereals at the rate of ¾ oz. per bushel. **Non-mercury fungicides:** Anticarie SD, Bunt-no-more, Co-op Hexa, No Bunt, Sanocide, Spergon SL, and Tritisan. These fungicides are relatively non-poisonous to humans. **They are recommended for the control of bunt only.** Rates of application for cereals are 2 oz. of Spergon, or ½ oz. per bus. of any of the others. **Dual purpose treatments:** Aldmer, Canuck Mercury Aldrin, Co-op Aldmer, Leytosan G91, Merlane H, Mergamma C, Puradrin, Seventy-seven Triple A, Shell Seed Dressing AM. The rate of application varies with the seeding, the aim being to use 1 oz. of the active insecticide per acre.
Covered smut	Barley	Heads are dull greyish color. Often remain in the boot under dry conditions. Spikelets, except awns, become masses of purple-black spores covered rather permanently by a thin membrane. Clumps of smut are conspicuous in the grain.	
False loose smut	Barley	The spikelets and flowers are destroyed and replaced by loose powdery smut masses which break up and blow away during flowering time. The smutted heads resemble those caused by true loose smut except that the latter are somewhat lighter in color.	
Covered and loose smut	Oats	Dark brown spore masses take the place of spikelets. They may be of the covered or loose type or intermediate.	
Head smut	Cultivated grasses	Loose type of head smut, spikelets changed to powdery black masses of spores. Plants once infected will produce smutted heads year after year.	Treat seed with non-mercury fungicides such as Arasan or the Captan (Orthocide) products.
Smut	Corn	Galls of various sizes at first covered by a white to grey membrane, occur on above-ground parts.	Rotate crops. Pick into a paper bag and burn smut galls as soon as they appear, to reduce infestation of soil.
Loose smut	Wheat	The heads become conspicuous dark brown, dusty masses of spores which blow away leaving the bare rachis. Not evident in threshed grain.	Use registered or certified seed. Use smut-free seed if available, or apply the hot water treatment as follows: soak in water at 70°F. for 5 hrs., place in wire baskets or loose bags and dip for 11 minutes in water held at 129° F. (126° F. for barley), take out and cool immediately in cold water and dry the seed so as to prevent molding or premature sprouting. Also the following treatment has proved effective in the control of true loose smut of barley: Salt-water soak treatment—place seed in container allowing room for expansion, fill container with a solution of 1% salt in water, hold at 66° F. for 85 hours, or 76° F. for 60 hours, then drain and dry to prevent sprouting or spoilage.
Loose smut	Barley	The grain is completely destroyed. The dark brown spore mass is covered with a fine membrane at first which soon breaks up. The spores are then blown away by the wind. The color of the spore mass is not so dark as that of false loose smut.	

Disease	Crop	Symptoms	Control
Common rootrot	Wheat, oats, Barley, Rye, Grasses	Brown discoloration of stem bases, roots, crown and lower leaf sheaths, somewhat more distinct on barley. Reduced in height, fewer stems and grains per head. Sometimes plants bleach, die and occasionally break over before maturity.	Growing non-susceptible crops in the rotation is recommended, *e.g.*, flax, rape, or legumes. Oats are beneficial in a rotation with wheat or barley. A two-year period of freedom from susceptible crops will eliminate much of the infection sources. Where conditions permit, the moldboard plow may be used to bury contaminated surface soil and trash, preferably just before seeding. Occasionally the rootrot fungi are seed-borne. (See Kernel smudge).
Seedling blight	Cereals	Seed rotting and death of seedlings before or after they emerge, causing thin stands.	Treat seed with a mercury fungicide or a Captan compound such as Orthocide.
Browning rootrot	Wheat, Oats, Barley, Millet, Grasses	Large brown areas in crops mainly on summerfallowed land in June. This appearance is caused by extensive browning and dying of the lower leaves. The tips of the crown roots are rotted. Stooling is reduced, seedlings stunted, maturity delayed and yields lowered.	Use phosphatic fertilizers. Maintain soil fertility. Sow seed in a firm seed bed. The working in of combine stubble reduces the disease. Avoid burning stubble. In some districts partial summerfallow has been beneficial. Thatcher wheat shows some resistance. Grasses sown in June may be severly injured.
Take-all rootrot	Wheat, Barley, Grasses	Frequently occurs in scattered plants or in patches in the black and dark brown soil zones. Plants are stunted and bleached. The roots are blackened and brittle. Plants often die prematurely and produce shrivelled grain.	After breaking native or cultivated sod use a rotation such as wheat, oats, wheat, fallow, followed by any good rotation. Maintain soil fertility. Take-all may become troublesome if wheat follows wheat.
Ergot	Grasses, Rye, Barley, Wheat, Oats	Conspicuous hornlike purple to black fungus bodies produced in place of seeds; present in threshed grain. Poisonous to man and animals.	Cut all nearby grasses before or when they come into head as they are the chief source of infection. Remove ergot from the seed with suitable cleaning machinery. If a few ergot bodies remain in the seed they are likely harmless when placed at seedling depth. Plow deeply, at least four inches, to bury ergot bodies that have fallen to the ground.
Septoria leaf and glume blotch	Wheat, Barley, Oats and some grasses	Light brown spots or blotches on the leaves and glumes, later grey and speckled as the black, tiny fruit bodies develop.	Seed from a diseased crop may need to be treated. (See treatments listed under bunt or covered smut.) Recommended rotations and cultural practices may be helpful.
Net blotch	Barley	Narrow distinctly brown spots having in general a net-like appearance. Found on leaves at any stage in the growth of the plant.	
Scald	Barley, Rye, Some grasses	Oval spots at first grey-green, later dry to pale or white center surrounded by brown margin.	Resistant varieties, crop rotation and turning under the crop residue. Seed treatment for seed-borne inoculum.
Kernel smudge (black-point)	Wheat, Barley	Light to dark brown discolorations usually at the embryo end but may spread somewhat over the kernel. Occasionally caused by a common rootrot fungus.	Clean the seed thoroughly to get rid of light kernels. Seed should be examined by a pathologist to determine the cause, especially if there is much discoloration. Treatment with a mercury fungicide may be advisable.
Bacterial black-point (Basal glume rot)	Wheat	An inky black point at the embryo tip.	
Scab (Fusarium blight)	Wheat, Barley, Oats, Rye	Bleaching and shrivelling of head or spikelet and seed, with a pinkish fungus growth mostly at the base of the spikelet in wheat, barley and rye. Scab (Fusarium) infested feeds are poisonous to hogs and man.	

Disease	Crop	Symptoms	Control
Leaf banding	Cereal seedlings	Narrow white bands on young leaves and sheaths about ½" to 1" apart. The top portions of seedlings frequently break over. (Caused by either: (1) high surface soil temperatures on consecutive afternoons, or (2) temperatures near or at freezing on consecutive nights.)	Slightly heavier seeding may be used as a precautionary measure. Trash cover in stubble fields gives some protection by providing shade. Soil packing is helpful.
Thin or shrunken seed	Wheat, Oats, Barley	Light, shrivelled seed caused by rust, rootrot or drought.	Remove the lighter seed with a fanning mill. Avoid deep seeding. Germination tests and treatment with a mercury fungicide are advised. Normal rates of seeding are usually satisfactory.
Grey Speck	Oats, Barley, Wheat	Areas in affected fields appear patchy and brown beginning at about the fifth leaf stage. Spots on leaves are greyish with brown margins. Severe damage may result in failure to head or in death.	The use of tolerant varieties, such as Ajax and Exeter, is helpful. Drill in feed-grade manganese sulphate at the rate of 100 lb. per acre at seeding time.
Frost injury in cereal seed	Wheat, Rye	Immautre greenish kernels and distinct transverse wrinkling of the seed coats of the larger kernels.	Clean seed to remove shrivelled kernels. Have the seed tested for germination.
	Oats	Frequently indicated by a whitening and looseness of the hulls.	
	Barley	When severely frozen the kernels are light in weight and shrunken.	
Piebald or yellow-berry	Wheat seed	A starchy condition of the endosperm giving the kernels a yellow appearance wholly or in part; caused by nitrogen deficiency. Embryo unaffected. Frequently found in black and grey soil areas.	Use 16-20-0 ammonium phosphate on fallow crop. On stubble crop use 16-20-0 or 27-14-0. Increase soil nitrogen by growing legumes. (See section on fertilizers.)
Halo blight	Oats	Spots or blotches on leaves and sheaths, with dead central portions surrounded by yellowish-green purplish margins, giving a halo effect.	Partial control may be obtained by use of mercury treatments as outlined for bunt of wheat. Most of the recommended varieties have some resistance.
Blast (non-parasitic)	Oats	Conspicuous white sterile spikelets, usually the lower ones.	No specific control is known. Avoid herbicide injury. Maintain soil fertility.
Seedling blight	Grasses	Seed rotting and death of seedlings before or after they emerge, causing thin stands.	Treat seed with Arasan or Orthocide. Avoid deep seeding.
Snow mould	Grass crops, Lawns, Golf greens, Winter cereals	Conspicuous white fungus growth overrunning leaves and crown tissues, causing dead patches in crop or turf. Occurs in spring frequently under or near melting snow.	Crop sanitation and rotation may help for cultivated grasses and winter cereals. For lawn and golf greens, a fall application of Merfusan or Agrox C is recommended. Another treatment is a mixture of equal parts of calomel and corrosive sublimate at the rate of 4 oz. per 1000 sq. ft. This mixture should be applied with enough dry sand to assure an even distribution.
Powdery mildew	Lawns	White to gray mould causing browning and death of leaves. Occurs in late summer chiefly in shaded areas.	May be checked by frequent dusting with sulphur or spraying with wettable sulphur.
Cold and winter injury	Grasses	Plants dead in spring, usually in patches. Crown and roots decayed.	Use hardy varieties. (See page 54). Avoid late fall cutting, pasturing and burning.

FLAX, SUNFLOWERS AND RAPE

Disease	Crop	Symptoms	Control
Rust	Flax	Light yellow spots followed successively by reddish-yellow and reddish-brown to black spots on leaves, stems and flower parts.	Use resistant varieties. (See page 52). The seed must be clean and free of tiny bits of rusted straw. Do not plant flax near land where a rusted crop was grown the previous year. Plow down rusted flax refuse by early June.
Wilt	Flax	Plants may wilt and die at any time from the seedling stage on. Others stop growth, turn yellow or greyish and remain unthrifty. Tops of plants are frequently hooked.	Use resistant varieties. (See page 52).
Seed decay and seedling blight	Flax	Flax seed may rot or seedlings fail to emerge. Seedlings one to four inches high wilt, fall over, and die. Thin stands frequently result. **Note:** This trouble should not be confused with damage from frost or early heat canker.	Sow only sound, clean seed. **All flax seed should be treated** with a mercury fungicide or a non-mercury Captan compound such as Orthocide 75 at the rate of 1 ½ oz. per bushel of seed. Flax should not follow flax.
Browning and stem break	Flax	The stem-break stage is recognized as a breaking over of the plants about one inch above ground level. Later, light brown spots appear on leaves, stems, and seed bolls. In severe cases diseased areas may have a brown cast. Infected seed is scaly.	
Pasmo	Flax	Irregular brown spots on leaves. Large brown spots on stems often alternating with bands of uninfected green portions. Occurs late in the season.	
Rootrot	Flax	Slight stunting with premature ripening of the plant and shrivelling of the seed. Wilt resistant varieties may be attacked.	
Frost injury of seed	Flax, Rape	Immature shrivelled white seed; maroon and dark green seed commonly appear in frosted flax.	
Die-back and scorch	Flax	The top third or, less commonly, the whole plant turns brown following hot, dry weather during ripening and the grain usually lacks plumpness.	Early seeding might help the crop to mature earlier and thus escape the heat damage of late summer.
Heat canker	Flax	Seedlings are girdled at ground level, collapse and die. Partially affected plants often continue to grow and may eventually break over at ground level.	Early and thicker seeding. Sow in a north and south direction.
Aster yellows (virus)	Flax	Plants upright, yellowish; leaves and fine branches bunched at top; flower parts yellow-green to purple, and bolls fail to form.	Early control of weeds in the crop and on nearby roadsides and waste land.
Rust	Sunflower	Dark brown rust spots on leaves, especially the lower ones. Leaves fall in severe cases.	Rotate crops and plow down or burn litter from rusted crop. Keep down volunteer seedlings.
Wilt and basal rot	Sunflower, Rape	Wilt of leaves, decay of roots, cankers form at base of stem, and hard black fungus bodies (sclerotia) may occur in or on diseased tissues. Heads and seeds may be affected occasionally.	Rotate with cereal and grass crops. Use clean seed.
White rust—downy mildew complex	Rape	Swollen, distorted and spiny structures at stem tips. Green when young, sometimes covered with white spore masses; later becoming hard and brown.	Use well-cleaned seed. Do not sow rape in or near a rape field of the previous year. Seed early. Arlo is usually less affected than Golden.

ALFALFA AND CLOVERS

Disease	Crop	Symptoms	Control
Crown rot	Alfalfa, Clovers	Dark decayed areas on crowns and upper parts of roots. Remainder of roots sound. Plants killed singly or in patches during late fall and early spring. Should not be confused with winter killing.	Crop rotation; do not re-seed with alfalfa for at least two years. Seed down new fields every two years or so where the disease is severe. Avoid late fall cutting, grazing, and burning. Resistant varieties are being developed.
Bacterial wilt	Alfalfa	Plants reduced in vigor, the leaves turn yellow and bleach, and the plants turn brown and die in summer. Leaflets small, stems small and more numerous than on healthy plants. Outer woody tissue of tap root pale-brown in color. On scattered plants or on groups of plants.	Use a short crop rotation. Clovers and grasses are not susceptible. Vernal is highly resistant and Ladak partially resistant.
Rootrots	Alfalfa, Clovers	Plants turn yellow and die, singly or in patches. Rotted areas on crown and roots. Diseases occur throughout growing season.	Crop rotation, including fallow and cereals.
Wilt and basal rot	Alfalfa, Clovers	Wilt of leaves, decay of roots, cankers form at the base of stem, and hard black fungus bodies (sclerotia) may occur in or on diseased tissues.	Rotate with cereal and grass crops. Use clean seed.
Seedling blight	Alfalfa, Clovers	Seed rotting and death of seedlings before or after they emerge, causing thin stands.	Seed treatment with non-mercury fungicides such as Arasan or a Captan compound such as Orthocide increases stand under certain conditions. Bacterial inoculum is injured to some extent by all fungicides; for this reason inoculation should be done immediately before seeding where treated seed is being used.
Cold and winter injury	Alfalfa, Clovers	Plants die singly or in patches in early spring. Roots rotted and shredded.	Use adapted varieties. Avoid late pasturing and cutting. Snow plowing and snow fencing on exposed areas helps to prevent drying out and erosion by wind.
Black stem	Alfalfa, Clovers	At first, small brown to black spots on stems and leaves which enlarge and join, often extending around the stem and into the crown. Stems may be scorched in appearance. Heavily infected leaves drop off.	Burning of heavy stubble and old straw is practicable if weather conditions are favorable. This destroys over wintering fungus and insect pests. Cut hay crop early.
Leaf spots	Alfalfa, Clovers	White, yellow, and brown round and irregular spots. Cause defoliation where severe.	

POTATOES, VEGETABLES AND MISCELLANEOUS

Disease	Crop	Symptoms	Control
Bacterial ring rot	Potatoes	Rolling, wilting, yellowing of leaflets on single stems, light brown cheesy rot of the vascular ring in tubers. Does not spread from plant to plant in the field, nor does it overwinter in the soil.	This disease is highly infectious. It is readily carried over winter in the tubers, therefore suspected seed lots should not be used for planting. (They may be used for food.) Disinfect tools, bags, machinery and storage houses with a quaternary ammonium compound, such as Re-Vab or Purina disinfectant, or with 5% lysol, (1 pint in 4 gallons of water). Bags should be soaked in the solution for 2 hours; storage bins and machinery may be sprayed or washed. Use Certified seed.
Blackleg	Potatoes	Bright yellow foliage. Stunting, yellowing, reduced and erect branching, rotting and blackening of base of stem, easily pulled, soft rot at the stem end in the tubers.	Use disease free or Certified seed. Do not plant the sets in cold, wet soil. Sets should be planted soon after they are cut. If necessary to hold them over, spread them out in a cool place, at temperature of 50-60° F.; small tubers planted whole may be of value.
Leak	Potatoes	Affected tubers are rubbery to the touch, internal tissues are watery and cream colored, exuding a yellowish liquid when subjected to pressure. Infection takes place through skin breaks at harvest time. A problem in transit and early storage.	High temperatures, coincident with early harvest favor the disease. Avoid leaving the tubers lying in the sun after digging. Provide adequate ventilation in the storage to lower humidity and cool the tubers. Handle potatoes carefully to avoid injuries.
Wilts	Potatoes	Severe wilting, stunting and premature ripening of the plant. Brown ring frequently seen when the tubers are cut.	Do not plant potatoes on the same soil oftener than once in four years. Discard tubers for seed purposes if they have internal discolorations. Use Certified seed.
Rhizoctonia (Black Scurf)	Potatoes	Small black fungus bodies adhere to the tubers. Sprouts may be killed, base of stem may be girdled, causing formation of aerial tubers.	Select seed free from black scurf and delay planting if soil is cold and wet. Use a long rotation of crops and avoid old garden soils. Dig potatoes intended for seed before the crops have completely ripened down.
Scab	Potatoes	Distinct, irregular, rough, corky spots on tubers.	Select disease free seed. Use a long rotation and avoid freshly manured land. Scab is generally less where potatoes follow sweetclover. Netted Gem is resistant but is not suited to dry prairie conditions.
Viruses	Potatoes	Leaf and stem abnormalities such as mottling, crinkling, necrosis, purple coloration and leaf rolling, also spindle shaped tubers and stunting of the plants.	Use Certified seed. Remove diseased plants, including the tubers, from crop intended for seed. (These tubers may be used for food.) Control aphids.
Dry rots	Potatoes	Affected tubers shrink and often develop hollow pockets internally, filled with a powdery mass of fungus growth. The fungi causing dry rot usually enter the tubers through wounds at digging time or later.	Use care in digging and handling to avoid bruises. Allow the potatoes to dry off before they are placed in storage. Maintain good ventilation in the storage place and gradually lower the temperature in storage to 35-40° F. Irish Cobbler and Katahdin are relatively resistant.
Early blight	Potatoes, Tomatoes	Attacks the leaves primarily, infrequently the petioles and stems. Tomato fruits are sometimes attacked, also potato tubers. At first small circular brownish-black spots appear. These spots increase in size and concentric rings usually develop within them. Defoliation occurs when the disease is severe. Early blight usually becomes severe only in the latter part of the season.	Timely and thorough spraying with a suitable fungicide will control early blight. Use Bordeaux mixture, Orthocide, Parzate, or Manzate.

Disease	Crop	Symptoms	Control
Late blight	Potatoes, Tomatoes	Purplish or brownish areas on leaves and stems with a water-soaked zone around each spot. Killing of the foliage may be very rapid. Potato tubers usually are infected at digging time. A dry irregular, spreading, brown, diffuse type of rot develops in storage. On tomato fruits, spots become dark brown, firm and wrinkled.	Avoid throwing out diseased culls in the spring; bury them or treat to kill the fungus. In blight areas avoid planting in closely enclosed spaces. If moisture is plentiful hill the potatoes generously so the tubers are well covered. Where the disease is present and spreading near harvest time, destroy the tops chemically or with a shredder **and delay harvesting for at least 10 days.** Spraying is effective only if started before the disease gets established, it must be repeated frequently. Use Bordeaux, Orthocide, Parzate, or Manzate. Resistant varieties are available; they should be used in disease areas. (See Page 76, Horticulture Section.)
Blossom-end rot	Tomatoes	Large, dark-colored, sunken, leathery spot occurring on the blossom-end of green or ripening fruit.	Maintain uniform moisture. Avoid planting tomatoes close to large trees, whose roots compete for moisture.
Soft rot (Sclerotinia rot)	Carrots, Parsnip	White mould on roots in storage causing a watery decay. Black fungus bodies develop.	Avoid early digging. Keep storage temperature about 35° F. Pick over before storage.
Yellows (virus)	Carrots (also on celery, parsnips, potatoes, etc.)	Outer, older leaves reddish or purple. Younger, central leaves dwarfed, distorted and frequently very numerous. Numerous branched rootlets growing out from the carrot root.	This disease is transmitted by a small green leaf-hopper. Application of DDT periodically will help.
Bacterial blights	Beans	Leaves show water soaked spots becoming brown and brittle. Pod spots are water soaked, later becoming sunken and amber yellow in color, and reddish around the margins. Yellowish spots occur on the seed.	Rotate crops. Use seed from a disease free crop. Discard discolored seed. Do not sow thickly and cultivate only when dry.
Rootrot	Peas, Sweet Peas	Reddish-brown decay of base of stem and root. Plants easily pulled up.	Rotate crops and destroy refuse from diseased crops. Obtain disease free seed. Ceresan at one ounce or Orthocide at 1½ ounce per bushel (about 2/3 teaspoonful per pound) are recommended treatments. Seed treatment is not entirely successful for leaf and pod spot. **Note:** Seed inoculated with nitrogen bacteria may be treated with Arasan, but not with Ceresan.
Leaf and pod spot	Peas	Definite, sunken, tan to brown spots, circular on leaves and pods, oval to long on stems, surrounded by a brown margin.	
Powdery mildews	Peas, Clover, Raspberry, Gooseberry, etc.	Gray to white powdery spots on leaves and stems.	May be checked by frequent dusting with sulphur. For small gardens, place the dust in a cotton bag and shake gently over the plants. Clean up refuse in the fall.
Fire blight	Apple, Crabapple, Saskatoon berry, Mountain ash Hawthorne	A fire blight effect is produced when blossoms, fruits, leaves and twigs wilt and turn brown, remaining on the tree. Cankers usually develop in the bark on twigs, limbs and trunks.	Use recommended varieties; they are known to possess some resistance. Prune out and burn all cankers while trees are dormant. Remove blighted twigs as they appear. Protect blossoms and new growth by spraying with Agristrep (4½ oz. in 100 gal. of water) when the first blossoms open and again at full bloom. Additional sprays are useful if the disease is severe. Do not spray during the 8 weeks before harvest.

ENQUIRIES

Whenever possible, send in specimens along with a brief history of the trouble. With the exception of firm fruits, tubers and roots, most specimens should be dried before mailing. Enquiries may be addressed to the Plant Pathology Section, Canada Agriculture Research Station, or the Department of Biology, both at the University of Saskatchewan, Saskatoon, Sask., or communicate with your Agricultural Representative.

Insect Pests of Plants and Livestock

RECOGNITION OF DAMAGE TO FIELD CROPS

Part Damaged	Type of Damage	Cause of Damage
Planted kernels	Seeds bored into, or only germ end destroyed.	Usually wireworms (p. 109); occasionally seed maggot.
	Seeds whole, no visible damage.	Poor germination due to poor seed, lack of moisture, seeding too deeply, poor seed bed or formalin treatment.
	Seeds swollen or decayed.	Seed-rotting fungi.
Young plants	Leaves and stems partly or completely eaten.	Grasshoppers (p. 112); sweet clover weevil, (p. 116); beet webworm, turnip beetle, flea beetles (p. 117).
	Tiny green aphids abundant on plants: (*a*) late-seeded barley turns brown and dies, plants covered with sticky "honey-dew"; (*b*) late-seeded spring grains or fall-seeded rye or winter wheat, turn brown and die.	Corn leaf aphid (p. 116). Greenbug (p. 116).
	Plants cut off at or near soil surface, tops disappear leaving only stubs underground.	Cutworms (p. 111); grasshoppers (p. 112).
	Underground part of stem shredded or bored into, but rarely cut off; dead plants in drill row, or plants with centre leaf dead, and outer leaves green.	Wireworms (p. 109).
	Central shoot withered, underground parts not attacked; tiny, whitish maggots or brown "flax seeds" between stem and base of the leaf.	Hessian fly (p. 114).
	Underground parts not cut off or bored into, discolored with brown or black areas; outer leaves die before central leaf.	Rootrots (p. 94), "Plant Disease" section.
	One or more narrow, whitish, slightly constricted bands on leaf blade.	Frost or excessive heat.
Maturing plants	Leaves, stems, heads, flax bolls or rape pods, chewed or dropped on the ground.	Grasshoppers (p. 112); army worms, flax bollworm, beet webworm (p. 116); flea beetle, turnip beetle (p. 117); sunflower beetle (p. 118); field crickets may damage flax bolls.
	Stems of ripe wheat girdled inside, broken off evenly at the soil surface, "sawdust" in stem.	Wheat stem sawfly (p. 114).
	Patches of grain with stems broken or cut off several inches above ground, heads eaten.	Gophers.
	Stems sharply bent but not chewed; (*a*) bend usually just above the lowest joint, tiny maggots or "flax seeds" under leaf sheath between bend and joint; (*b*) deformed stems.	Hessian fly. Disease, physiological condition, wind or hail.
	Heads empty or kernels shrivelled: (*a*) wheat heads turn white and contain no grain, though stems and leaves below top joint remain green; (*b*) empty heads and numerous, small, whitish spots on stems; (*c*) whole plant ripens prematurely, often stunted, with no evidence of chewing.; (*d*) whole plant bleaches.	Wheat stem maggot, or physiological condition. Hail at earlier stage of growth. Rootrots (p. 94), "Plant Disease" section. Firing, caused by hot winds and drought.
	Tiny green aphids cluster on the heads and stems of grain, but no evidence of damage.	English grain aphid (p. 116).
	Similar infestations on alfalfa and sweet clover.	Pea aphid, on both; sweet clover aphid.
	Alfalfa buds "blasted", turn yellowish white or gray, fail to open; excessive drop of flowers and small seed pods; discolored and shrunken seeds found before frost occurs.	Lygus and other bugs (p. 116).
	Seed of alfalfa hollowed out, with small hole where adult insect emerged.	Alfalfa seed chalcid (tiny, black wasp).

WIREWORMS

Wireworms are slender, hard-bodied shiny, yellow worms, the largest about one inch long. They do not curl up as cutworms do when disturbed. Each year some wireworms reach full growth and change to a pupal or resting stage during July. The pupae usually are found in the top three inches of soil. In about two weeks they change to "click" beetles which overwinter and lay eggs in the soil the following spring. Tiny wireworms hatch in June and early July. These worms may live for five to 10 years in the soil. They move only short distances. A field may remain infested for years, though damage may be noticed only in crop seeded on fallow.

Wireworms are most troublesome in the medium and light soils of the prairie area, but damage may occur in heavy soils also. Fields cropped continuously to wheat or grass are almost certain to be severely infested. **Wireworms attack all grain crops, especially wheat and spring rye.**

Damage.—Wireworm damage to cereals is indicated by thin patchy stands. Stands usually are heavier in the wheel tracks of seeding equipment than between them.

Damage is generally heaviest in crops seeded on summerfallow or on rebroken grass-land. Patches may gradually enlarge and eventually become bare. With severe damage, the whole crop may be destroyed. Wireworms attack and destroy seeds but most damage occurs to the seedling stage. The underground stems are bored into and shredded, but not cut off. The outer leaves of older plants generally remain green for some time after the central shoot is killed. These plants may live if conditions are favourable. Dead plants may remain in the drill row for some time. Potatoes and other root crops are damaged by wireworms tunneling in the tubers, stems, and roots. Other susceptible garden plants may be killed by damage to underground parts of the stems.

Choice of crops.—Wheat and spring rye are very susceptible to wireworm damage. Oats and barley are more resistant. If recommended seeding practices are followed, oats and barley can be seeded safely, except where infestations are severe. Oats should be seeded early. Late seeded oats may be severely damaged, particularly in a hot, dry spring. Flax may suffer serious damage on rebroken grassland. Winter wheat, fall rye, sweet clover, and alfalfa usually escape serious injury. If seeded late, and not well established in the fall, winter wheat and fall rye may be appreciably thinned in the spring. Corn, sunflowers, or potatoes should not be planted on severely infested land unless a chemical control is used.

CONTROL

Seed treatments on cereal crops.—Wettable powder and liquid seed dressings containing aldrin, dieldrin, gamma BHC (lindane) or heptachlor, will give immediate control of wireworms in cereal crops. The insecticide may be used alone for wireworms. It may also be used with a mercury fungicide (dual-purpose) for the control of wireworms and seed-borne diseases. Seed treatment is recommended on wheat planted in infested fallow or land rebroken from grass. One seed treatment usually reduces wireworm numbers enough so that little or no damage will occur in later crops if recommended seeding practices and periodic clean summerfallowing are used. However, watch summerfallow crops for damage and use a seed treatment again if damage begins to appear.

Treat the seed uniformly. **Determine the correct amount of seed dressing to apply from the directions on the container.** A higher rate will not improve control and may harm the plants. A lower rate may not protect the crop or give satisfactory reduction of wireworm numbers.

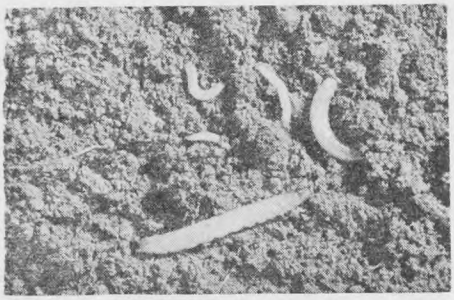
Do not apply dual-purpose dressings, containing an insecticide for wireworm control and mercury for smut control, to seed already treated for smut.

Wettable powder wireworm seed dressing may be applied anytime during the winter before seeding. Longer storage may damage seed and reduce wireworm control. The effects of storage on grains treated with liquid seed dressings are not known for the Prairie Provinces.

Apply dual-purpose dressing to wheat at least one day before seeding, and to oats and barley at least one week before seeding, to give satisfactory disease control.

Use sound dry seed and plant it properly to ensure best results from seed treatments.

Seeding practices.—To increase plant vigour and reduce wireworm damage, follow recommended seeding practices. (See "Cropping Systems and Cultural Practices" section). Seeding too deep, particularly, will reduce treatment effectiveness. Avoid very early or very late seeding.



Wireworms

Reseeding.—Land on which a crop has been destroyed by wireworms usually can be reseeded immediately without danger of further serious damage. However, recommended seeding practices must be followed.

Summerfallowing.—In areas where summerfallow is a recommended practice use clean summerfallow every two or three years to reduce wireworm infestations: (1) Destroy all green growth during June and July to starve newly-hatched wireworms. (2) Do not work summerfallow deeper or more often than is necessary for weed control.

Two or three summerfallows may be needed to reduce a severe infestation as much as one seed treatment. If combined with good seeding practices, summerfallowing provides the most efficient control of wireworms in fields where damage occurs, but where expense of a seed treatment appears unwarranted. Summerfallowing also will prevent an increase in wireworm numbers where most of the worms have been killed by seed treatment.

Seed dressings on crops other than cereals.—Seeds of corn, peas, beans, and sunflowers can be safely treated with either aldrin, dieldrin, or gamma BHC at one ounce of toxicant per 60 pounds of seed. Combination dressings containing mercury should not be used on legumes such as peas and beans because the mercury is harmful to nitrogen-fixing bacteria and to the seeds themselves. Sugar beets can be treated with four ounces of actual aldrin, gamma BHC, or heptachlor, per 100 pounds of seed. Do not overtreat or emergence may be reduced.

Brome grass seed may be safely treated with two ounces of 50 percent wettable powder of aldrin, dieldrin, or heptachlor per 8 pounds of seed. Other grasses, including brome, may be treated with ½ ounce of a 10 percent dust of these insecticides, or of gamma BHC, per pound. Prepare this by mixing one part of the 50 percent dressing with four parts of flour. If companion grain crops are used, treating the grain may be safer and more effective than treating the forage seed directly.

Do not treat potato seed pieces with insecticides.

Chemical soil treatments.—These are recommended only in gardens or on land to be used for potatoes or crops from which large returns per acre are expected. Soil treatment is too expensive a control in grain crops.

From 80 to 100 percent of wireworms can be killed by treating the soil either with five pounds oi active aldrin or heptachlor or 10 pounds of active chlordane, per acre. The chemical should be applied on top of the soil as a dust or spray and then immediately be worked into the top four to six inches of soil. If not worked in right after the application, the chemical will lose some strength. Treatment may be done either in fall or spring. Spring treatments should be applied as early as possible so most wireworms will be killed before seeding. The land should remain practically free of wireworms for several years. Watch for signs of wireworm damage each year after treatment, and treat again as soon as damage begins to appear.

Band treatments with either aldrin or heptachlor at three pounds actual per acre will give good protection to potatoes in light wireworm infestations only. These are applied from a planter fertilizer applicator during planting, either as dusts or granules mixed with fertilizer, or as insecticide-impregnated fertilizers.

Do not use BHC in any form, including gamma BHC (lindane), as a soil treatment because it may taint potatoes and other root crops.

Cutworms

CUTWORMS

Cutworms have fleshy, soft bodies and when disturbed usually curl up and remain motionless. The two most common kinds that attack seedling crops in the spring are the pale western cutworm and the red-backed cutworm. The **pale western cutworm** is a uniform pale grey color and is a pest of the prairie and margins of the parkland. The **red-backed cutworm** is moderately dark grey on the top half of the body and has two broad dull-red stripes along the back. It normally occurs in the park and forest belt but may extend well into the prairie area. It may be found in gardens throughout Saskatchewan.

Both kinds feed mainly at night, cutting completely through the young stem at or just below the soil surface. They will attack all field and garden crops. Damage normally occurs from late in May until the end of June. When full grown, 1½ to 2 inches long, they change to dull brown pupae 2 to 4 inches deep in the soil. The moths emerge from the pupae and lay their eggs in the soil from mid-August to mid-September. The eggs hatch in the spring. A field that is infested one year may or may not be infested the next, depending on the condition of the field at the time of egg-laying.

Dry weather in May and June favors the survival of the cutworms. This usually results in an increase of moths in the fall and of cutworms the next spring. A preliminary forecast, based on rainfall records and larval numbers, is published annually in mid-July. Watch for this forecast and use the recommended control measures.

Several kinds of cutworms overwinter as partly grown larvae. These usually finish feeding before the spring seeded crops emerge but occasionally one of them, the **army cutworm**, damages crops in southwestern Saskatchewan.

Climbing cutworms, mainly the **flax bollworm, bertha armyworm** and the **wheathead armyworm** occur on crops in July and August. All overwinter as pupae in the soil. The moths emerge in mid-summer and lay their eggs on the host plant. See Table 1, page 116, for information on these cutworms.

PALE WESTERN CUTWORM CONTROL

Prevent egg-laying in summerfallow. —Destroy all green growth as late in July as possible and then leave the fields undisturbed by tillage or livestock until September 15. Moths lay their eggs in loose dusty soil. The crust formed by rains after the tillage will prevent egg-laying except on certain types of soil where the crust breaks down when dry.

Weeds, and wind erosion following heavy rains, sometimes become a problem before mid-September. It may be necessary to choose between the loss of moisture due to weeds, or the seriousness of the wind erosion problem, and the possible loss by cutworms.

Starve young cutworms before seeding. Very young cutworms can be starved if they have started to feed and their feed is then destroyed. Allow volunteer grain and weeds to grow from 1 to 2 inches high and then cultivate. Seed 10 to 14 days later. This method is recommended chiefly for stubble fields in areas where a severe outbreak has been forecast.

Chemical control. — Spray infested fields as soon as damage is seen with any one of the following emulsion concentrates: chlordane, 24 oz.; dieldrin, 6 oz.; endrin, 4 oz. of active material per acre. Apply in 6 or 7 gallons of water per acre when using a standard field sprayer.

Reseeding of damaged fields is not safe until the cutworms have been killed by chemicals or have stopped feeding (usually during the last week in June).

RED-BACKED CUTWORM CONTROL

Prevent egg-laying in summerfallow. —Use the same method as for the pale western cutworm with one important exception—if tall weeds develop after mid-August the field should be worked. Eggs are laid in the soil on weedy summerfallows and not in clean soil, even if loose. They are also laid in weedy patches in cereal crops and in fields of rape, peas, alfalfa and sweet clover.

Chemical control. — Look for cutworms in fields likely to be infested (see above) before there is visible damage and spray if necessary. At this time cutworms are small and easily overlooked. They can be found by scratching in the soil around weeds and cut plants. One or two cutworms per square foot can cause severe damage, especially to rape and flax.

The recommended insecticides and rates per acre of active material are: aldrin, 8 oz.; chlordane, 24 oz.; dieldrin, 4 oz.; endrin, 4 oz.; heptachlor, 8 oz. Apply in 6 or 7 gallons of water per acre when using a standard field sprayer.

Poisoned bait (Formula 6, page 120) is effective and may be preferred for

treating gardens and small infested patches in fields. It should be scattered thinly and evenly over infested fields about dusk on warm, calm evenings. Baiting is more effective if done early in the season when larvae are small, and particularly when the soil surface is slightly damp from recent rains.

Reseeding.—Same as for "Pale Western Cutworm."

GRASSHOPPERS

Over 75 different kinds of grasshoppers have been found in Saskatchewan, but only three or four of these damage field and garden crops. These, and most others, overwinter in the soil as eggs that hatch in the spring. A few harmless kinds winter as partially grown grasshoppers, and their appearance early in the spring often gives rise to incorrect reports that grasshoppers have begun to hatch.

Nearly all Saskatchewan grasshoppers lay their eggs in the upper one and one-half inches of soil, in pods containing about 10 to 80 eggs, the number depending partly upon the kind of grasshopper. Pest grasshoppers lay eggs in the fall, and these hatch in the spring, normally during a period extending from May into June. The newly-hatched grasshopper resembles the adult but is wingless, and only about one-eighth of an inch long. As they grow, young grasshoppers shed their skins about once a week, usually five times, becoming full grown and winged about late June in outbreak years. After sexual maturity, egg-laying may continue as long as food is available and the weather remains warm enough. In Western Canada, there is not more than one generation a year.

Grasshopper breeding grounds. — Spring infestations of grasshoppers come from: (1) egg beds adjacent to cultivated fields on roadside sod, borders of sloughs, in pastures, and occasionally on ditch banks, drift ridges and banks of irrigation canals; (2) eggs scattered throughout stubble fields.

Clean summerfallow even with heavy trash is free of troublesome numbers of eggs.

In Saskatchewan, large areas of native grassland are rarely breeding grounds for grasshoppers harmful to field crops. Other kinds of grasshoppers may increase in native grasslands sufficiently to become troublesome, but these rarely invade field crops. Infestations may appear to come from such grasslands if (1) young grasshoppers are first driven off stubble fields into grassland and then return to crops, or (2) egg beds occur on native sod between crops and open range. Such egg beds are associated with crop land and not with the native grasslands.

GRASSHOPPER CONTROL

The grasshopper forecast. — Watch the annual forecasts for information regarding the expected extent and severity of outbreak for the coming season. These forecasts provide the guide to individual and community planning for grasshopper control. When serious outbreaks are expected, a preliminary forecast is published in the press in the fall; this is followed by the final forecast published on the familiar coloured posters and elsewhere during the winter.

Protecting crops from grasshopper damage is based on (1) **planning:** the threat of grasshopper outbreaks may require decisions to change normal cropping practices temporarily, (2) **tillage,** to reduce hatching and to starve grasshoppers that hatch in stubble fields, and (3) **chemical control,** to kill grasshoppers that threaten uninfested crops.

Planning.—Stubble fields are poor risks for cropping during years of combined drought and grasshopper outbreak; do not sow crops in them unless you are prepared to spend extra time and money to protect them. There is no known tillage method by which fields containing "moderate", "severe" or "very severe" egg infestations can be made completely safe for crop production. Invest your effort in fields summerfallowed the previous year, and handle infested stubble fields so as to prevent grasshoppers that hatch in them from invading crops on summerfallow.

Starvation control. — Newly hatched grasshoppers usually starve to death before finding their way out of a field that has no green food. Therefore, destroy all weed and volunteer growth on fields to be summerfallowed just before or soon after the grasshoppers begin to hatch. Implements must be so adjusted and the work done under such conditions that all plant growth will be destroyed. Early tillage constitutes good summerfallowing practice for controlling weeds and storing moisture, and therefore this control involves no extra expense. If rains fall and weeds grow

again before all the grasshoppers have hatched and starved to death, destroy the weeds by prompt additional tillage or poison the grashoppers. Grasshoppers that hatch very near crops may get into them in spite of efforts to starve them; crop margins should therefore be watched during and after hatching.

If partly-grown grasshoppers are present at the time of a tillage operation, apply chemical control in one of the following ways: (1) treat the entire field before tillage; this is probably the surest way to prevent them invading a neighbour's crops; (2) poison them as soon as they enter grain fields; this may require prompt action; (3) if there are enough food plants, leave green trap strips around and in the field being tilled so that the grasshoppers will collect in them, and poison them promptly. Till up the trap strips as soon as they have served their purpose.

Chemical control.—If your farm is in a forecast area, keep a close watch during hatching time. Individual farms may have worse grasshopper problems than the forecast would indicate. Watch for grasshoppers in areas of sod near cultivated fields, in seedling crops sown on stubble lands, in neglected stubble fields, and in the margins of other crops. Poisons act quickly and will prevent damage if applied as soon as dangerous numbers appear.

Aldrin, chlordane, dieldrin, heptachlor or toxaphene applied in sprays, dusts, or baits will kill grasshoppers. They are both contact and stomach poisons, and in sprays and dusts, should be applied if possible both to the grasshoppers and their food plants. They may be used under a wide range of conditions, against newly hatched grasshoppers in young seedling crops to flying adults in tall rank crops. Apply them at the rates recommended for grasshopper control on the container labels, or in currently issued leaflets and bulletins (see also Formula 4a, page 120).

Freshly applied sprays remain effective after showers and through short periods of rainy weather, if the sprays dry before the rains begin.

During fine weather, immense numbers of grasshoppers may hatch from an egg bed each morning for several days, and move into nearby crops quickly. Be prepared to poison these every few days. Do not expect one spray treatment applied at a standard rate to give adequate protection for more than three or four days.

Poison baits are effective for the control of most pest grasshoppers in short or sparse and open vegetation. They do not work well in tall rank vegetation. You may find them useful in gardens or pastures where the residues of poisons in sprays and dusts are not desired. You may spread them by hand on a small scale, or with home-made or other mechanical spreaders on a large scale. Dry bran baits are effective, and may be applied with a duster with the booms removed, and with the hopper fitted with a sufficiently large opening.

Prepare wet bait with bran, water, and a poison such as aldrin or chlordane emulsible concentrate. For each 100 pounds of bran, stir one 8-ounce cupful of poison concentrate into 10 gallons of water. Add the liquid to the bran, mixing thoroughly until the bran is thoroughly moistened. Wet baits are more effective when used after storage for about 24 hours. Dry baits have to be prepared using special equipment, which is normally available only to commercial formulators.

Spread baits on the morning of days that promise to be at least partly clear and warm. Spread thinly at the rate of about 10 pounds of dry, or 20 pounds of wet bait per acre. After a uniform spreading job, flakes of bait spread at this rate are easily seen on the ground.

Protecting fall-sown crops. — Adult grasshoppers bask in warm places along the edges of ripening crops or stubble fields in the fall. Here, they are ideally situated to attack seedling crops of fall-sown grains. A few grasshoppers can do a lot of harm at this stage. If you notice grasshoppers while seeding fall rye, etc., poison them before the crop comes up. If you can only apply the poison along the edge of the field in which the insects are sheltering, more grasshoppers may later work their way to the edge of the field or fly over the treated strip, and more poisoning may be needed. If treatments are necessary after the fall-sown crop comes up, observe closely to see where the grasshoppers are and treat the whole infested area. (See Canada Department of Agriculture Processed Publication Series No. 126).

Control in bee pastures. — Where grasshoppers must be controlled in crops that are being foraged by bees, use toxaphene. (See next paragraph).

Control in pastures and forage crops. —It has recently been shown that even very small amounts of poison residues of all of the poisons recommended here for the control of grasshoppers, when consumed with grazed or fed fodder,

will accumulate in the fatty tissues and appear in the butter fat of milk cows. Although this will probably do no injury to the animals themselves, poison residues are not permitted in food products for human consumption. Therefore the use of poisons such as aldrin, dieldrin, chlordane, heptachlor and toxaphene in pastures and hay crops can no longer be recommended, unless they are used in baits properly distributed. There is at present no substitute poison that can be recommended for application in sprays or dusts.

Precautions.—Operators of sprayers and dusters, and persons handling insecticides in any form, should protect themselves (see page 121).

WHEAT STEM SAWFLY

The slender, wasp-like adults are less than ½ inch long, black with yellow legs and narrow bands on the abdomen. Because of their size, colour, and habit of flying close to the ground they are seldom seen. The females lay their eggs inside wheat stems from the middle of June to the middle of July. The white colored grubs that hatch tunnel inside the stems, destroying each other. Finally, only one remains alive in each stem. Just before harvest, the grub moves to ground-level. It girdles the stem from the inside, plugs the upper end of the stub, and overwinters in it. The girdling weakens the stem so it breaks off. These fallen stems at harvest, and the "sawdust" present inside after mid-July make sawfly damage easy to recognize.

Damage is usually greatest in early-seeded, sawfly-susceptible wheats and spring rye. Durum and winter wheats, and some varieties of barley, may become severely damaged some years. The crop loss occurs in three ways: (1) The grub feeding in the stem reduces the nourishment reaching the head. This causes from 10 to 20 percent loss in yield, and often a reduction in grade. (2) The weakened stems lodge more easily. (3) The stems break off at ground level when ripe and fall to the ground. Many heads therefore are not picked up by the harvesting machinery. In wet falls heads may sprout. This damage is greatest in crops that are not swathed before they are dead ripe. Losses may exceed 10 bushels per acre.

Sawflies come from the previous year's stubble. If susceptible crops are seeded on or close to infested stubble, serious infestation is almost certain to result.

WHEAT STEM SAWFLY CONTROL

Grow Chinook or Rescue varieties of wheat in all areas where they are recommended. Chinook is superior in quality to Rescue, but is slightly less sawfly-resistant. These varieties are resistant because they are solid-stemmed. When the spring is particularly cloudy, their stems may become partially or completely hollow. They will then lose some or all of their resistance. The seed from these plants will produce solid-stemmed resistant plants with a normal spring the following year.

Where Chinook or Rescue wheat is not recommended use the following practices as required:

(1) **Seed immune or resistant crops** to eliminate sawflies from single fields or from whole districts. Flax and oats are immune to sawflies. All varieties of barley recommended in Saskatchewan except Hannchen are highly resistant.

(2) **Use shallow tillage in the fall or spring to reduce infestations.**—Sawfly grubs can be destroyed in large numbers by shallow tillage that exposes the stubs containing the grubs on the soil surface. They will be dried out by heat and wind. One-way discs or discers are the most suitable implements for this tillage. Fall tillage may be done any time after harvest. Spring tillage should be carried out during the last half of May and the first week of June. Deep tillage, unless stubs are buried at least five inches, is of no value. It only delays emergence of the sawfly adults.

(3) **Use trap crops to protect vulnerable crops from infestation.**—Chinook or Rescue wheat makes an effective trap because only a small percentage of sawfly grubs survive. With light infestations, plant a trap approximately one rod wide of either variety around the infested stubble or around the crop to be protected. The trap should be seeded early. In the parkland and adjacent areas permanent strips of brome grass should be seeded on road allowances and headlands. This grass is an excellent trap because it harbors the native parasites of the sawfly. Few sawflies can survive in it.

(4) **Seed vulnerable crops late to avoid infestation.** — In certain years sawfly-susceptible crops seeded after May 24 may escape infestation. However, this method is effective only when the spring is warm and dry, causing the sawflies to emerge early.

Harvesting infested crops.—Sawfly-

infested stems do not usually break off and fall until the crop is nearly ripe. Hence, the actual loss in severely-infested fields can be reduced greatly by cutting while kernels are in the late dough stage. This is recommended where over a quarter of the stems are infested. It will not destroy any sawflies, and is recommended only as a means of saving grain. The degree of infestation can be determined by spliting a handful of stems gathered from several locations throughout the field.

Do not burn stubble to destroy sawflies.—The larvae are below ground and will escape damage. Many parasites of the sawfly over-wintering in stubble will be destroyed.

INSECTS IN FARM-STORED GRAIN

Insects will multiply rapidly in moist grain, causing it to heat. Grain that is uniformly dry will not spoil or become infested.

The more common pests occurring in stored grain in Saskatchewan are the rusty grain beetle, several kinds of fungus beetles, and mites. The fungus beetles feed primarily on moulds in the off-condition grain. They do not attack sound kernels. Larvae of the rusty grain beetle feed on the germs of wheat, oats, and barley. Mites feed on grain dust as well as on whole kernels. Grain infested with mites usually has a musty odour.

Preventive control measures are easier and more economical to apply than curative measures. First, the granary should be swept out thoroughly and made weatherproof. If the floor and walls are damp, sweep hydrated lime into cracks. Next, spray all inside surfaces with one of the following insecticides at one gallon per thousand square feet: pyrenone (containing 2.0 percent piperonyl butoxide and 0.20 percent pyrethrins); lindane (one pound 25 percent wettable powder in 2½ gallons water); malathion (10 fluid ounces 50 percent emulsible concentrate in one gallon water); or methoxychlor (one pound 50 percent wettable powder in one gallon water).

Allow about two weeks for the insecticide to dry before loading grain in the granary. Do not put grain from the new crop on top of old grain. New grain often contains more moisture than old and will attract insects. Clean up and destroy accumulations of old grain on the ground near the granaries. This grain usually contains insects that may infest the granary. Keep ventilators open during dry weather to air surface grain.

Examine stored grain every two weeks.—Feel surface grain with the hand and probe deeper with an iron pipe to detect tough, damp, or heating grain. During warmer weather use water traps to detect insects in grain. These consist of water-proofed cups filled with water and sunk in the grain to within a half inch of the surface. Three or four traps will be enough for each granary. Insects are attracted to the water and can be easily seen.

Move and clean infested grain during the winter.—Insect infestations discovered in winter can be controlled by cooling the whole mass of grain to 25° F. for seven to 10 days. The grain must be transferred slowly in thin layers during the coldest weather to piles outside or to another granary. The grain should be cleaned during moving. Put it through a fanning mill, combine, or threshing machine. Or, discharge it through a portable elevator into a sloping chute fitted with a six-foot section of screen. This will assist in lowering the temperature and drying the grain.

Moving and cleaning grain during warm weather often gives satisfactory control when a good job is done. When this method is not effective or not possible, the only alternative is to fumigate.

Fumigation.—A fumigant is usually applied as a liquid to the surface of the grain. It evaporates to form a poisonous gas that sinks through the grain mass. Fumigation is most effective when used on relatively dry, clean grain under warm, calm conditions. Use it in a tightly-constructed granary or one that has cracks sealed. Surface grain that is "tough," crusted, or mouldy and "hot spots" within the grain mass should be broken up before applying fumigant. Infestations in "hot spots" can often be more readily controlled by direct application of fumigant to the area through pipes. Before attempting to fumigate infested grain, obtain further details from the Entomology Laboratory, Saskatoon, or your local Agricultural Representative. Obtain a copy of "Control of Insects in Farm-Stored Grain in Western Canada," Canada Department of Agriculture, Division of Entomology, Processed Publication 118. Follow safety measures carefully.

TABLE 1.—OTHER INSECT PESTS OF FIELD CROPS Read page 121, Precautions, and page 122, Application, before using any insecticides.

Insect	Plants Attacked	Description: Injury, Pest, Season of Attack, Area	Control (numbers in brackets refer to formulae, p. 120; quantities to amount of actual insecticide)
APHIDS English grain	Wheat, oats, barley.	Tiny green aphids cluster on heads and stems from mid-dough stage to harvest; no evidence of damage to plants or kernels.	Control usually not necessary.
Greenbug	Late-seeded, spring grain and fall-seeded rye and winterwheat.	Tiny green aphids cause seedlings to turn reddish-brown and die; damage may occur anytime from early July to freeze-up.	Spray immediately damage is noted with malathion 50 per cent emulsion (7).
Corn Leaf	Late-seeded barley; occasionally corn.	Tiny, dark green aphids cause plants to turn brown and die; plants covered with sticky "honey-dew".	Spray barley as soon as damage is seen with malathion 50 per cent emulsion (7); control on corn rarely necessary.
ARMY WORM	Oats, wheat, brome grass; occasionally other grains and grasses; rarely legumes.	Large, dark, greenish-brown worms with conspicuous stripes down side, eat leaves, drop heads and panicles: damage continues in stook; worms feed late afternoon and evening, hide under clods and stooks by day; sometimes "march" in armies. Occurs chiefly in eastern half of province.	Spray crop when worms feeding with ½ pound aldrin, ¾ pound DDT, or 1½ pounds toxaphene per acre; or scatter poisoned bait (6) in afternoon or early evening when worms feeding. Stop migrating "army" with a deep furrow and poisoned bait.
WHEAT HEAD ARMY WORM	Wheat and barley; occasionally other grains and grasses.	Ripening kernels partly eaten by slender, striped, brown, tan or greenish worms; heads not cut off; worms frequently abundant in loads of straight-combined grain, but damage does not continue after grain is cut. Occurs throughout prairie area.	If control of worms necessary spray with ¾ pound DDT per acre or dust with 1 pound DDT per acre.
BERTHA ARMY WORM	Flax, rape, vegetables, weeds; occasionally sweet clover and alfalfa.	Bolls, seed pods, flowers, and leaves eaten or cut off in July and August. Worms green and inconspicuous on foliage when young, later change to conspicuous green to velvety black. Moths emerge in June and July from pupae wintering 3-4 inches deep in soil; eggs laid in large patches on underside of leaves. Throughout Saskatchewan.	Spray infested fields with 10 ounces DDT, 1½ pounds toxaphene, or 2 ounces endrin per acre. If honeybees foraging in or near the field apply DDT when bees not foraging. If endrin to be used, notify beekeepers; residues are toxic to bees for 5 days. Use derris (1) on edible foliage of vegetables.
FLAX BOLL-WORM	Flax	Moth lays eggs in flax flowers; newly-hatched worm bores into boll, causing boll to turn brown prematurely. The worm, green with four white stripes, remains inside until all seeds eaten, emerges and hollows out additional bolls from the outside. When crop begins to ripen, worms enter soil and pupate. Moths emerge the following July.	Starting in mid-July examine bolls regularly; determine per cent with worms inside by splitting several hundred bolls; if 3 per cent of the bolls are infested in an average crop it will pay to spray. Use 10 ounces DDT (one quart emulsion) per acre when most of the worms have emerged.
BEET WEBWORM	Flax, rape, alfalfa, pigweed, Russian thistle, etc. (Does not attack grains or grasses.)	Leaves eaten by slim, active green caterpillars, marked with fine black lines and circles. Worms may chew surface layer from stems and pods giving crop a white appearance. Armies may migrate from weedy fields into crops. Eggs laid by slender grey moths on leaves of host plants. Outbreaks occur in July and August.	Spray infested crops with 2 pounds toxaphene, 8 ounces dieldrin, or 4 ounces endrin per acre. If most of worms over ¾ inch long increase quantities by one-half. If honeybees foraging in or near field and dieldrin or endrin to be used notify beekeepers; residues are toxic to bees for 5 days.
SWEET CLOVER WEEVIL	Sweet clover	Seedling crop may fail to appear because leaves eaten as soon as they emerge; crescent-shaped notches chewed in leaves of surviving plants from spring until fall in both first and second year stands. Insect is small, dark grey snout beetle difficult to see. Occurs throughout province.	Avoid seeding new stands adjacent to old sweet clover. Prevent destruction of young plants in the spring, particularly in the seedling year, by spraying with ½ lb. dieldrin or ½ lb. heptachlor or 1½ lbs. DDT per acre when shoots first appear through the ground in the spring.
PLANTBUGS Lygus, Plagiognathus, Adelphocorus	Alfalfa grown for seed.	Buds blasted, turn yellowish-white or gray; plants may be somewhat stunted; flowers fall prematurely, and small seed pods drop, leaving abundance of stripped racemes; discoloured and shrunken seeds present before frost occurs.	Thoroughly burn alfalfa stubble and debris in the spring before growth starts. When alfalfa is well budded but before many flowers are present spray or dust with ½ lb. dieldrin or ¾ lb. DDT or ½ lb. heptachlor per acre. In fields that have not been thoroughly spring-burned spray when the alfalfa is just coming into bud with ½ lb. dieldrin or 1¼ lbs. DDT or 1 lb. heptachlor per acre. Alfalfa that has been sprayed must not be fed to livestock.

For further information on these or other insect pests of field crops, write to the Entomology Section, Canada Dept. of Agriculture Research Station, Saskatoon.

Read Page 121, Precautions, and page 122, Application, before using any insecticides.

Insect	Plants Attacked	Description: Injury, Pest, Season of Attack, Area	Control (numbers in brackets refer to formulae, p. 120; quantities to amount of actual insecticide)
ANTS	Plants not eaten. Feed on sweets.	Make holes, mounds, and loosen soil around roots; invade houses. Often indicate presence of aphids.	Dust or spray the infested area with chlordane (4a). Repeat weekly as long as ants are present.
APHIDS Plant lice	Currants, peas, potatoes, delphiniums, fruit trees, etc.	Leaves deformed, curled, discolored, by tiny soft, sucking insects which cluster on the under surface of the leaves, tips of twigs, seed pods, etc. Leaves may drop. Late spring and summer.	Spray the insects with malathion (7), nicotine sulphate (3), or pyrethrum (2) before the leaves are curled. Apply spray forcefully against the undersides of leaves. Repeat as needed.
BEET WEBWORM (incorrectly called armyworm)	Garden plants, alfalfa, rape, flax, pigweed, Russian thistle, etc. (Does not attack grains or grasses.)	Gardens quickly eaten by slim, small, active caterpillars, green, marked with fine black lines and circles. Outbreaks occur in early July or in August. Armies migrate from weeds when these dry up or are eaten.	To prevent invasion of gardens destroy all surrounding weeds in early June; or spray or dust weeds with toxaphene. If gardens or crops are infested spray or dust non-edible foliage with two pounds technical toxaphene per acre. If necessary to treat edible parts of plants use only pyrethrum (2) or derris (1).
BLISTER BEETLES	Broadbeans, onions, caragana, potatoes, beets, honeysuckle, ash.	Blossoms and leaves devoured by large, soft, active slender beetles, blue, bronze, black, gray, or spotted. Appear suddenly, often in large swarms, May to August.	On edible portions of plants spray or dust beetles with pyrethrum (2) or derris (1); on shrubs or potatoes use DDT dust, or DDT, aldrin, or chlordane sprays (4a). Act promptly. Repeat daily as long as beetles are present.
CABBAGE WORMS	Cabbage, cauliflower, turnips.	Large circular holes eaten in leaves and hearts of plants by green caterpillars. Masses of soft green pellets. Throughout summer.	Dust young plants with derris (1), pyrethrum (2), or DDT (4). Use only derris or pyrethrum after heads begin to form.
CURRANT CATERPILLARS	Currants, gooseberries.	Leaves devoured by green, spotted caterpillars. Appear with first leaves and occur throughout summer.	Dust or spray the foliage with derris (1) or DDT (4a, b) as soon as leaves are well formed; repeat as necessary. After fruit appears use only derris (1) or pyrethrum (2).
CURRANT MAGGOT	Currants, gooseberries.	Infested fruit ripens and drops prematurely. Fly inserts eggs into immature berry. Tiny white maggot feeds within the berry.	Control difficult. Spray bushes until they drip with DDT or methoxychlor (1 tablespoonful 50% wettable powder to 1 gallon of water) when 80% of the blossoms have withered or fallen, and again 10 days later.
CUTWORMS	All garden crops.	Stems cut off at ground level by dull colored fleshy caterpillars which curl up when disturbed. Feed by night, hiding in soil by day. May and June.	Scatter poisoned bait (6) on a warm evening; or spray soil surface with dieldrin, aldrin, or chlordane (at five times strength shown in Formula (4a). Use 1 gal. per 500 sq. ft.; or use a prepared dust.
EUROPEAN CORN BORER	Sweet corn.	Tassels broken over, ears and stems tunnelled. Worms up to 1 in. long, dirty white or pinkish with black head. Egg masses on lower surfaces of leaves, mid-July to mid-August.	Four applications of DDT (4b) at intervals of five days, the first in late July when eggs begin to hatch. Do not feed treated plants to livestock.
FLEA BEETLES	Cabbage, turnip, rape, radish, potatoes, etc.	Small round holes eaten in leaves, and in fall seed pods damaged by tiny, quick jumping beetles. Early seedlings may be destroyed. Present in spring until July and again from August onwards.	Dust or spray with derris (1) or DDT (4a, b) as soon as plants emerge or are transplanted. Repeat as necessary. Within 3 weeks of harvest use only derris on edible plants.
GRASSHOPPERS	All garden crops.	Entire plants devoured quickly by adults, more slowly by young hoppers.	Broadcast poisoned bait (6); or spray non-edible foliage in and around garden with aldrin, dieldrin, heptachlor, chlordane (4a).
GLADIOLUS THRIPS	Gladiolus	Silvery blotches on leaves and blasted blooms in summer, small dark pits on corms in winter. Adults quick moving, tiny, slender with four long narrow hairy wings. Young wingless. Pest cannot live out doors in winter so eradication of all stages on corms in storage is most important.	**Corm treatment:** In fall soak corms for six hours in Lysol solution (4 tsps. per gal. water) dry and store; or, dust with 3% DDT (1 oz. per bus. of corms), store in open containers. **Plant treatment:** four applications of DDT dust or spray (4b) at intervals of 10 days, beginning when plants are 10 inches high.

TABLE 2 (Continued)—INSECT PESTS OF GARDENS

Insect	Plants Attacked	Description: Injury, Pest, Season of Attack, Area	Control (numbers in brackets refer to formulae, p. 120)
GRAPE LEAF-HOPPER	Virginia creeper, grape; shrubs and flowers when creeper defoliated.	Yellow spotting and drying of the leaves with the damage developing from the ground upwards. Very small, yellowish, sucking insect; immature stage wingless and on under-surface of leaves; mature stage winged, very active. Spring and summer.	Spray both sides of the leaves thoroughly with DDT (4a, b) as soon as creeper is well leafed out and again during mid-July or whenever leaf-hoppers become abundant. Community action desirable.
POTATO BEETLE ("bug")	Potatoes, wild tomato, egg plant.	Foliage devoured by round backed yellow beetles with 10 black stripes, and by fat reddish grubs. Throughout summer.	Dust the plants with derris (1) or DDT (4), or apply DDT, aldrin, or chlordane (4a) as soon as beetles or grubs appear on plants.
RASPBERRY MITE	Raspberry, etc.	Leaves turn brown and dry up. Under surface of leaves covered by very fine silken web. Pest almost too small to be seen. Most troublesome in dry years.	Spray undersides of leaves thoroughly with Ovotran 50% wettable powder (1½ ounces in 10 gallons of water) or Aramite 15% wettable powder (3½ ounces in 10 gallons of water). Apply first just after leaves appear. Repeat just before flower buds open. Or spray with derris (1) or malathion (7) as soon as first symptoms seen. Repeat as needed.
ROOT MAGGOTS	Rutabaga, cabbage, cauliflower, radish.	Root surface grooved, or flesh bored into by small, white, legless maggots. Young plants killed, older plants wilt. Adults similar to houseflies; lay tiny, elongated, white eggs on or near base of stem, *beginning early to mid-July* and continuing to end of August.	**Plant treatment for rutabagas:** Drench plants and six inches on each side of row with heptachlor or dieldrin, (4c) one gal. on 50 ft. of row, *at first appearance of eggs*. Repeat twice more at intervals of 10 days. **Pre-planting treatment for rutabaga: cabbage: cauliflower,** apply 2½% heptachlor, or dieldrin dust 1 lb. on 70 ft. of row, in bands 12 in. wide on intended rows; rake into soil. No suitable control on radishes.
	Onions only.	Seedlings wilt and die. Roots and lower stems tunnelled by maggots. Infested onions rot. Eggs, maggots, and adults similar to above. First generation eggs laid about plants late May to early June, and second generation mid-to late July. Throughout summer, but worst in June.	Use seed treatment *or* plant treatment in spring; follow with plant treatments in late summer if needed. **Seed treatment:** Weigh 50% heptachlor or dieldrin wettable powder equal to 1/16 weight of dry seed, or calomel equal to weight of dry seed; moisten seed and mix with insecticide until seeds coated; plant immediately. **Plant treatments:** Three applications of 4% calomel dust (5), or DDT spray (4b) (1 gal. on 40 ft. of row) at 10-day intervals; treat plants and 2 ins. on each side of row. In spring make first application when onions in "loop stage", usually in late May. In summer make first application in late July when eggs found about plants.
ROSE CURCULIO	Roses.	Buds and flowers ruined by holes bored by small red and black snout-beetles. Approximately mid-June to mid-July.	As soon as buds appear, dust or spray plants with DDT (4). Keep well covered with poison during beetle period.
SUN-FLOWER BEETLE	Cultivated and wild sunflowers.	Holes eaten in leaves, flower bracts and petals by round-backed cream colored beetles with black stripes, and by fat yellowish-green grubs. June to August.	Spray with DDT, chlordane, toxaphene, or aldrin (4a), or apply dusts of these insecticides.
TURNIP BEETLE	Turnip, cabbage, cauliflower, mustards, argentine rape, etc.	Leaves and pods eaten by red and black striped beetles. Invade fields and gardens from nearby rape, mustard, pepper-grass, etc., in latter part of June and again in August.	Destroy mustard weeds in and around garden early in the spring. Dust infested vegetables with derris (1), or, dust or spray non-edible foliage with DDT (4a).
WIRE-WORMS	Potatoes, lettuce, corn, onions, carrots, and other plants.	Seedlings wilt and die from underground boring by slender, hard bodied, shiny, yellow worms. Seeds and sprouts destroyed. Potato tubers, carrots, etc., tunnelled.	In spring or fall dust or spray with 2 ounces of aldrin or heptachlor, or 4 ounces of chlordane, per 1,000 square feet; immediately work into top 4 to 5 inches.

For further information on garden insects, write to the Entomology Section, Canada Dept. of Agriculture Research Station, Saskatoon.
Send samples of insects and damaged plants.

Read page 121, Precautions, and page 122, Application, before using any insecticides.

TABLE 3.—CONTROL OF COMMON INSECT PESTS IN SHELTER BELTS, SHADE TREES AND ORCHARDS

Insect	Plants Attacked	Description: Injury, Pest, Season of Attack, Area	Control (numbers in brackets refer to formulae, p. 120)
APHIDS	Spruce, pine, tamarack, balsam.	Clusters of soft, brown, green or black insects on the trunks, branches, twigs or needles.	Spray trees thoroughly with Malathion (7), or nicotine sulphate (3). For elm, spray before leaves become curled.
	Caragana, maple, elm, poplar, willow, ash, fruit trees.	Leaves curled or discolored by small, soft insects which cluster on the trunk, branches, leaves or seed pods.	
BLISTER BEETLES	Caragana, ash, lilac, honeysuckle.	Blossoms and leaves devoured by swarms of large, active beetles.	Dust beetles with DDT or spray with DDT, aldrin or chlordane (4a, b), malathion (7); or with diazanon or Sevin at the highest rate recommended on container.
BORERS	Poplar, ash, birch, pine, spruce, fruit trees.	Trees or branches weaken and die; holes in the stems and branches, areas of dead bark, caused by white grubs burrowing in the wood. Grubs present all year.	Special treatment required. Send sample of grubs and damage to the Forest Nursery Station, Indian Head, Sask.
BOXELDER BUG	Manitoba maple.	An annoying house pest, clustering on sunny walls and invading dwellings in autumn. Young are wingless, scarlet; adults ½ inch long, winged, flat, black with red lines.	On outside walls or dead trees, spray with kerosene; on living trees spray clusters with DDT (4a, b), pyrethrum (2), derris (1), or chlordane (4a).
CANKER-WORMS	Manitoba maple, elm, ash, fruit trees.	Small holes appear in leaves; later foliage is completely eaten by brownish-green caterpillars which spin silken threads. Present in May and June.	As soon as damage appears spray trees with DDT (4a, b) or malathion (7).
CECROPIA CATER-PILLAR	Manitoba maple, poplar, ash, elm, fruit trees.	Leaves devoured in July. Young caterpillars are blackish, spiny, older caterpillars are large, green, with vari-colored projections. Winter in large, brown, silken cocoons on twigs, weeds, etc.	Spray caterpillars with DDT (4a, b). Hand-pick and destroy caterpillars and cocoons.
LEAF BEETLES	Poplar, willow.	Foliage skeletonized by black grubs, causing scorched appearance, or devoured by small to medium vari-colored beetles, from May to August.	Dust insects with DDT, or spray with DDT (4a, b).
Orchard **TENT CATER-PILLAR**	Rose, gooseberry, cherry, apple, etc.	Leaves eaten in May and June by dark, hairy caterpillars that construct conspicuous tents of white silk.	Cut out and destroy tents during cool weather or at night. Dust or spray insects with DDT (4a, b) derris (1), or pyrethrum (2).
Forest	Poplar, willow.	Leaves eaten in May and June by dark, hairy caterpillars that cluster on stems and branches but do not make tents; caterpillars often migrte in "armies".	Dust insects with DDT or spray with DDT (4a, b).
SAWFLIES	Spruce, larch.	Needles eaten by small green, brownish, or greyish-green "caterpillars" with shiny red or black heads; on spruce in June; on larch in July.	Spray insects with DDT, aldrin, chlordane or toxaphene (4a, b), or malathion (7).
SPRUCE SPIDER MITE	Spruce, larch.	Yellowish mottling of needles with fine, silk webbing around twigs between needles; mites almost too small to be seen. Present from early May to end of season.	Spray trees thoroughly with Kelthane or Tedion or Aramite during third week in May and again during mid-summer. Use the highest rate recommended on the container.
PINE NEEDLE SCALE	Spruce, pine.	Yellowish mottling of needles caused by small, waxy, white, elongate scale insects that are present on the needles all year.	Spray trees thoroughly with malathion 50% emulsion, 16 fl. oz. to 20 gallons of water, at the end of first week in June, and again during second week in August.

For further information on shelterbelt pests, write to the Forest Nursery Station, INDIAN HEAD, Saskatchewan.
Send samples of insects and damaged plants.

FORMULAE

1—DERRIS (Rotenone)

Use as directed on containers. Dust or spray both plants and insects. Derris can be used safely even on plant parts to be eaten immediately. Store in tightly closed containers in a cool dry place.

2—PYRETHRUM

Use pyrethrum preparation, liquid or powder, as directed on the container. Spray must be used promptly after mixing. The spray or dust must hit the insects as pyrethrum kills only by contact. Apply during the warmest part of the day. Pyrethrum is not dangerous to man.

3—NICOTINE SULPHATE SPRAY

Use as directed on containers. Effective only when it hits the insect as it kills by contact. Very poisonous if swallowed or inhaled, or on contact with the skin, but the poisonous effect disappears rapidly after application to plants. Vegetables and fruit can be eaten safely a day or two after treatment.

4—HYDROCARBON INSECTICIDES

Kill insects by contact or when eaten. They will not injure most plants if used according to directions. Do not use on edible parts of plants within three weeks of harvest. Do not use household or barn sprays on plants and animals. For safety follow precautions given on the container.

Prepare spray by using **water and one of the following insecticides** in the quantities indicated. If other concentrations of these insecticides are used, the quantities should be modified accordingly. Mix all sprays thoroughly and agitate frequently to maintain mixture.

(4a)

	Small quantity	Acre quantity	For trees
Water	1 gal.	sufficient to spray 1 acre	40 gal.
Emulsible concentrate			
Aldrin, 2½ lbs. technical per gallon	1 tsp.	12 fl. oz.	7 fl. oz.
Dieldrin, 2 lbs. technical per gallon	½ tsp.	5 fl. oz.	- - - - -
Heptachlor, 2 lbs. technical per gallon	1 tsp.	15 fl. oz.	- - - - -
Chlordane, 10 lbs. technical per gallon	1 tsp.	8 fl. oz.	7 fl. oz.
Toxaphene, 10 lbs. technical per gallon	2 tsp.	16 fl. oz.	16 fl. oz.
DDT, 25%, 2.5 lbs. technical per gallon	1 tbs.	40 fl. oz.	33 fl. oz.

(4b)

	Small quantity	Acre quantity	For trees
Water	1 gal.	80 gal.	40 gal.
Wettable powder			
Aldrin 20%	2½ tsp.	15 oz.	8 oz.
Dieldrin 25%	1 tsp.	4 oz.	- - - -
Heptachlor 25%	2 tsp.	12 oz.	- - - -
DDT 50%	2 tbs.	2 lbs.	1 lb.

(4c) FOR ROOT MAGGOTS ONLY

	Small quantity	Acre quantity
Water	1 gal.	80 gal.
Wettable powder		
Heptachlor 50%	1 tsp.	4 lbs.
Dieldrin 50%	1 tsp.	4 lbs.
Emulsible concentrate		
Heptachlor, 2 lbs. technical per gallon	1 tbs.	1 gal.
Dieldrin, 2 lbs. technical per gallon	1 tbs.	1 gal.

Dusts of various concentrations are obtainable. Apply according to directions on the container.

5—CALOMEL DUST

Thoroughly mix one part calomel (mercurous chloride) with 24 parts flour, slaked (hydrated) lime, talc, or fine road dust.

6—POISONED BAIT

	Small quantity	Acre quantity
Bran	1 gal.	25 lbs.
Water	1 qt.	2½ gal.
Aldrin, chlordane or dieldrin emulsible concentrates	2 tbs.	8 fl. oz.

If concentrations other than those listed in formula 4 (a) are used, modify quantities accordingly. Mix water and poison and stir into the bran until it is uniformly moistened and free of lumps.

7—MALATHION

	Small quantity	Acre quantity	For trees
50% emulsion	1 tsp.	20 fl. oz.	10 fl. oz.
or			
25% wettable powder	2 tsp.	2 lbs.	1½ lbs.
Water	1 gal.	Sufficient to spray one acre	40 gal.

Malathion kills insects on contact or when eaten with plant material. Follow strictly the directions and heed the precautions given on the container.

CAUTION—Do not apply to vegetables and fruits within 10 days of harvest.

THE USE OF INSECTICIDES

PRECAUTIONS IN HANDLING INSECTICIDES

Insecticides are poisons developed to kill insects. **Humans and animals can be accidentally poisoned by swallowing the insecticide, by eating insecticide-contaminated food, or by prolonged exposure to dusts and sprays.** Continued exposure to small quantities may not cause visible symptoms but can damage the liver or other vital organs and can accumulate in the fat and milk of animals.

If blurred vision, headache, tightness of chest, or nausea are noticeable after exposure to insecticides, **call a physician at once or take the victim to a hospital immediately.** Be certain what insecticide was used. Take the label of the container to the doctor, as the antidote is listed on it.

If medical or hospital attention is not immediately available, apply the following measures:

If the poison was swallowed, induce vomiting as quickly as possible. This can be done by giving one teaspoon of salt or ground mustard in a glass of warm water, or by sticking a finger down the throat. If poisoning is by BHC, lindane, chlordane, DDT, dieldrin, endrin, heptachlor or toxaphene, give hot coffee or tea containing one ounce of epsom salts **after the stomach has been emptied.**

If the poison was inhaled, move patient into fresh air. If necessary, give artificial respiration.

The following precautions should be adhered to whenever insecticides are used:

1. **Read the label on the container.** This may save your life and prevent accident. It will name the product and its most effective use. It will also tell how to handle the material and what should be done in case of accident.

2. Wear protective clothing e.g. coveralls and rubber gloves. Special care should be exercised with concentrates. Respirators, with filter and cartridge recommended for the specific insecticide, and goggles should be worn for volatile materials or extremely toxic dusts or sprays. With daily exposure (**custom operators**) complete coverage with waterproof clothing is a must.

3. Change contaminated clothing as soon as possible and wash before re-use.

4. If pesticides are spilled on the skin, wash immediately and thoroughly with soap and water, as insecticides, especially systemics, are absorbed through the skin.

5. While spraying or dusting, prolonged exposure should be avoided, sprays and dusts should not be inhaled, smoking (especially hand-rolled cigarettes) should be avoided, and all exposed parts of the body should be washed immediately after.

6. Do not contaminate feed or water for livestock. Follow the rates of application shown on the labels, and **strictly observe the cautions with regard to the use of treated crops.**

7. Keep all pesticides in their original containers with proper labels. Store them in a safe place away from food or where food is handled. Keep out of reach of small children, pets, or irresponsible persons.

8. Destroy all pesticide containers by burying or burning and avoid smoke from such fires.

9. Equipment must be in good working order to avoid leaks and clogging, and should be thoroughly cleaned after use.

FORMULATIONS

Most insecticides are sold in the form of dusts, wettable powders, emulsible concentrates, and oil solutions.

Dusts should be applied dry in the concentration in which they are manufactured. They will not mix with water to make a spray.

Wettable powders mix with water but do not dissolve. They should be applied in sprays, except where they are stated to be suitable as dusts, i.e. warble powders. Generally, wettable powders contain a high concentration of the insecticide. If not diluted with water, they are expensive to use and may be dangerous to the animals treated or to animals feeding on treated foliage.

Emulsible concentrates mix with water to form a milky emulsion. Apply, only after dilution as directed, to either plants or animals. Do not use if the components have separated out because of freezing or other reasons and will not form a milky emulsion.

Oil solutions generally should be used without further dilution. They should never be applied to plants. They should be applied to animals only in self-applicators (back rubbers) or, when recommended, as mist sprays.

APPLICATION TO CONTROL PLANT INSECTS

Field Crops.—Apply **dusts** in the late evening or early morning when it is calm and dew may be present. Apply **sprays** at any time except when it is hot or windy.

Apply emulsible **concentrate sprays** with any standard type of sprayer. Apply **wettable powder sprays** only with sprayers equipped with piston or roller-type pumps and providing mechanical agitation of the suspension in the tank. Do not attempt to apply them with the standard field sprayers commonly used for 2,4-D application. (See Farm Power and Equipment Section, page 42.)

Row Crops.—Use row crop dusters or sprayers if available. You can use ordinary field crop equipment, but you should plug the spray nozzles or dust jets where necessary to lessen waste of insecticides.

Gardens.—To control **aphids or mites,** the insecticide must cover the undersides of the leaves. A sprayer or duster is essential. Wettable powders may be applied with a hand sprayer not equipped with an agitator, but the container must be shaken frequently to keep the insecticide in suspension. For treating to control chewing insects, a sprayer or duster is more efficient. If necessary, spray solution can be sprinkled on the plants with a watering can or with a brush. Dusts can be applied from a can with small holes in the bottom or from a small bag of coarse mesh cloth attached to a stick.

Shelterbelts and Orchards.—**To treat orchard trees, or for limited treatment of shelterbelt trees,** use garden dusters or sprayers, or any type of power equipment. To use an ordinary field sprayer, disconnect the spray boom from the pump and attach a spray gun.

To treat well-grown shelterbelts for control of fall cankerworm, spruce sawfly, or other tree pests, use a universal sprayer, high - pressure high - volume sprayer, orchard duster, or turbine sprayer-duster.

Thoroughly clean all equipment that has been used to apply herbicides before using it to apply insecticides. 2,4-D may seriously damage vegetables or other broad-leaved crops. Thoroughly wash such sprayers, first with soap and water, then with household ammonia solution. Finally, flush with water. Thoroughly clean all spraying and dusting equipment after applying insecticides. Be sure to drain pumps of sprayers.

APPLICATION TO CONTROL LIVESTOCK INSECTS

Modern insecticides, properly used, will control most insects attacking livestock. Insect control will increase weight gains, grade of carcass, milk flow, and health of animals generally. It is essential for profitable livestock production in small farm herds as well as large ranch herds.

Satisfactory control can be obtained in small herds by hand operated equipment, but in large herds, power equipment is essential.

Sprayers, to be suitable for livestock insect control, must: be capable of maintaining any pressure up to 500 pounds per square inch; be able to deliver at least four gallons per minute; be equipped with a mechanical agitator in the tank; have an adequate strainer between the tank and the pump; and have suitable drain cocks for draining pump and tank.

High pressures are necessary for livestock insecticides to penetrate the hair. The chemical must reach the skin to control warbles and lice and the scab must be broken to control warbles with rotenone. Universal type sprayers are most suitable and are available at reasonable cost.

When using wettable powders in spray machines, special precautions should be taken to see that the pump is thoroughly washed after each use. Such materials should never be left in the tanks over night.

Single nozzle adjustable spray guns are most satisfactory for warble fly control. Triple nozzle spray guns are most suitable for spraying animals for louse control, barns and other buildings for fly control, and farmsteads for mosquito control. Fan-type guns can be used for warbles, lice, and other livestock insect control work, particularly when using systemics. Most multiple nozzle and fan-type guns are not adjustable.

Self applicators (back rubbers) for applying chemicals to livestock are very satisfactory for control of horn flies. They are of doubtful value in the control of other biting flies (horse flies, deer flies, mosquitoes, black flies, etc.) and lice. They have no value in the control of warbles.

Suitable applicators may be cheaply made with materials available on any farm. Several strands of barbed wire may be loosely twisted together and wrapped with old sacking, until a roll

about six inches in diameter has been completed. This is then tied tightly every four to six inches with heavy cord. This roll may be attached to two posts placed a rod apart. It should be fastened four to five feet above the ground at the posts, and allowed to sag within a foot of the ground in the centre. It should be soaked with a five percent solution of DDT or methoxychlor in a suitable solvent. (Solutions suitable for use in applicators can be secured from most chemical companies.) **Solutions containing DDT should not be used for dairy cattle.** This applicator will require about one to 1½ gallons of the mixture. It will be necessary to moisten it with additional chemical at about weekly intervals. Repairs can be made with additional old sacking and cord. There are many other ways of making such a roll and other methods of attachment to posts. Any method which provides a suitable absorbent roll and allows the animals to treat themselves is satisfactory. The applicator should be located near the water supply or salt block or any area where the cattle loaf.

If poisoning of livestock by insecticides is suspected call a veterinarian. Symptoms are in general similar for most animals. They are nervousness, wild stare, tremor, slobbering, diarrhoea, loss of appetite and weight, paralysis and convulsions. Animals in poor condition are more susceptible to poisoning by livestock sprays than those in good condition.

Sanitation.—Failure of insecticides to control certain insects, particularly houseflies and stableflies, is often blamed on **resistance** of the insects to the insecticides. Such failures nearly always occur because of **lack of sanitation** and not because the insects have become resistant to the insecticide. If manure, litter, and other breeding places are not cleaned up the insects may appear in too large numbers for insecticides to control. **Sanitation is essential.**

Where trade names of products are mentioned in this "Guide" they are to be considered as examples and their mention does not necessarily constitute a recommendation.

Read page 121, Precautions, and page 122, Application, before using any insecticides

Insect	Nature of Damage	Control
LICE (of cattle) (For lice of other animals and poultry see next page)	Biting lice feed on skin surface and irritate animals. Sucking "blue" lice, common in winter, suck blood, reduce milk yields and weight gains, cause rash, severe irritation and anemia. Lousy animals get thin and may die. Lice begin to show up in the fall as dark patches where the hair is thin, particularly along the underline. A lousy animal has greasy patches of hair and an odor of stale blood. Eventually the hair is rubbed off in patches.	Wash, dust or spray (at 400 pounds pressure using No. 4 discs or fans) with malathion, lindane, methoxychlor, rotenone (warble powder), toxaphene or DDT. Use wettable powders, emulsible concentrates or dusts. Treat once with malathion or twice with other chemicals 12 to 14 days apart. **For dairy cattle or animals** within one month of slaughter use only rotenone or methoxychlor. Chemical must reach skin. Fall treatment is best. Where cold weather treatment is required, use a dust. When spraying for lice the operator should attempt to hold the gun within 12 inches of the animal's body.
CATTLE WARBLES (Heel flies or gadflies.)	Warble flies worry and frighten animals when laying eggs on legs and lower part of body. This causes gadding which reduces milk yields and weight gains. **Grubs** in animals reduce milk and meat yields and carcass grades, and cause unthriftiness, and injury to hides. Contrary to general belief, warble flies cannot bite or sting.	Community treatment is recommended but single farm control can be effective. **Fall treatment:** Systemic chemicals for warble control are now available for beef cattle only as sprays, bolus, drench or feed additive. At present, sprays are considered the most satisfactory. Begin treatment as early in September as possible. **Read carefully recommendations on container.** In spraying, amounts will vary depending on thickness of coat; average ¾ gals. on calves, 1½ gals. on yearlings, 2 gals. on mature cows. **Spring treatment:** Use special warble powder (rotenone). Begin in early March, or when holes in hide are about as big around as a pencil. Treat at 30-40 day intervals as long as live grubs are present. Method: (a) dairy cattle and small beef herds, scrub the wash over backs of cattle with a stiff brush or rub powder well into holes, (b) in large herds use a power sprayer at 400-450 pounds pressure, using a single nozzle gun with 5/64 inch opening. Hold gun 18-20 inches above the back and limit the size of cone of spray to 4-6 inches. Use powder prepared especially for power sprayers. Use one half to one gallon per animal. Fall treatment prevents carcass and hide damage and other losses and reduces infestation for coming year. Spring treatment only reduces infestation.
HORN FLIES	Irritation and loss of blood caused by small, dark grey, biting flies clustering behind the shoulders of cattle. Sometimes attack sheep and horses. Mainly July-August.	Spray backs of animals with 1 pound 50% wettable DDT or methoxychlor in 10 gallons of water or 1 gallon 50% emulsible malathion in 100 gallons or with pyrenone livestock spray. *Do not use DDT or malathion on milking dairy cows* or on any animals within one month of slaughter. Power sprayers or back rubbers may be used for range animals.
HOUSEFLIES	The house fly carries and spreads diseases and parasitic worms of man and animals. The maggots are found in manure, garbage, and other decaying materials.	**Sanitation is essential:** Clean up breeding places in barns, feedlots, garbage and privies. Treat privies with chloride of lime. Spray manure piles with malathion. Spray interior and exterior of barns, etc., with DDT, methoxychlor, malathion, chlordane, dipterex, diazinon, etc., but read label before buying and observe special precautions for dairy barns. If power sprayer is used limit disc opening to 4/64 inches. Poison baits, pyrenone space sprays, aerosols and household residual sprays are also very effective.
STABLE FLIES	Painful bites, loss of blood. May transmit disease.	Eliminate breeding places: spread manure and wet litter, plow under stack bottoms. Spray barn interior with residual insecticide (see houseflies); spray animals as for horn flies.
BLACK FLIES "Sand Flies"	Feeding by small hump-backed, greyish flies on thinly-haired parts of animals, particularly cows and bulls, causes loss of blood, soreness, swellings, serious illness or death within a few hours of first mass attack late in May or in June. Milk production may be reduced. Swarms of killing species come mainly from rocky rapids of the Saskatchewan River. Less dangerous, but highly troublesome species, emerge from other rivers.	Watch carefully for dangerous swarms of these flies particularly in late May and in June; as soon as any appear stable valuable animals, particularly bulls. Small swarms may occur throughout the summer. Use smudges to protect animals that cannot be stabled. Serious damage is most common within 50 miles of the South and North Saskatchewan Rivers. Some relief may be obtained by spraying animals as for mosquitoes.

Insect	Nature of Damage	Control
MOSQUITOES	Worry and loss of blood. May transmit disease. Mosquitoes breed mainly in temporary pools in weedy roadside ditches and pasture depressions. Our species **do not** breed in extensive permanent sloughs nor in dugouts.	Drain breeding places in entire community, or kill larvae soon after pools form in the spring with a film of oil, with or without DDT added (1/10 to ¼ pound per acre). To kill adults use a residual spray of DDT wettable powder on vegetation and buildings to a height of 10 feet. Pyrenone livestock sprays, smudges, or commercial fly repellents will give some relief.
HORSE FLIES (Deer flies, Bulldogs)	Painful bites, loss of blood, and unrest; gadding in cattle. May transmit disease.	Provide darkened shelters for animals. Use pyrenone livestock sprays. Fly nets or coverings may help.
HORSE BOTS (and nose flies)	Flies annoy animals while laying eggs on lips, throat, and legs. Eggs or young grubs are swallowed and cling to wall of stomach, intestine, and anus, causing rundown condition and sometimes death. These flies cannot bite or sting.	Provide darkened shelters for pastured animals. Use nose muzzle and underjaw protection. Treatment by veterinarian with carbon bisulphide capsules before December 15.
SHEEP KEDS (mis-called sheep ticks)	Brownish, flattened, tick-like insects about ¼ inch long. Pollute fleece and reduce vitality due to loss of blood and irritation. Animals damage fleece by rubbing.	Pack sheep tightly into pens or chutes and thoroughly spray at 250 to 400 pounds pressure or dip, using lindane, toxaphene, rotenone (derris), DDT, chlordane or malathion. Derris is safe to use immediately after shearing. One week to 10 days should elapse to allow cuts to heal before other insecticides are applied.
TICKS (not to be confused with sheep keds.)	Ticks fasten themselves to most animals running on infested scrub-covered pastures and ranges, particularly in May and June; suck blood, causing weakness. May transmit diseases, such as Rocky Mountain spotted fever and tularaemia.	Destroy rodents on ranges. Keep animals off infested areas. Spray infested animals with toxaphene or lindane wettable powder or dust. Individual ticks may be picked off by hand. Mostly confined to the south of the Province.
LICE (of sheep, goats, and hogs.)	Irritation, rash, loss of hair or wool, poor condition.	Spray, dip, dust, or wash with lindane, methoxychlor, rotenone (warble powder), toxaphene, DDT or malathion. Treatment and precautions as for cattle lice. Rotenone is poisonous to hogs.
LICE (of poultry.)	Chickens appear dopey and listless; egg production falls off.	Clean poultry house, spray with lindane or malathion, and then completely replace nest material, or spray or paint roosts with lindane, nicotine sulphate or malathion, or dust birds with rotenone or DDT dust or sodium fluoride or flousilicate.
MITES (of poultry.)	Scaly legs.	Scrub, then dip legs in equal parts of kerosene and raw linseed oil. Clean and spray chicken houses as recommended for chicken lice.
	Chicken roost or red mites; suck blood at night. On roosts and walls during day.	Paint roosts or spray houses well with lindane or malathion. Ventilate well.
	Northern fowl mites; remain on the birds; congregate at vent and neck where they suck blood.	Paint roosts with nicotine sulphate; repeat in two weeks. Treat litter with malathion dust. Dip birds in sulfur 2 ounces, detergent 1 ounce, and warm water 1 gallon.
FLEAS (of animals and birds.)	May carry disease and tapeworms. Adults small, dark, shiny, jumping insects. Larvae up to ¼ inch long; in bedding.	Thoroughly clean floors, carpets, and especially the sleeping quarters of dogs and cats. Then spray or dust quarters and dust animals with methoxychlor, rotenone, or malathion. Rid dogs and cats of fleas with dusts containing rotenone, methoxychlor, or pyrethrum.
MANGE AND SCAB MITES	Attack horses, cattle, swine, and sheep. Irritation causes animals to rub and scratch; scabs form in advanced stages, and there is a loss of hair or wool.	**When on horses, cattle, or sheep, must be reported to the Health of Animals Branch immediately.** When on hogs, scrub, or spray at 350-400 pounds pressure, premises and animals with lindane using 1 pound 50% wettable powder in 100 gallons of water. Two scrubbings or sprayings are necessary at 10-12 day intervals. Clean up infested premises.

Use livestock insect poisons according to directions on the containers. Do not use household or oil solutions on livestock.
For further information on insect pests of livestock and poultry, write to the Entomology Section, Canada Dept. of Agriculture, Research Station, Saskatoon.

LIVESTOCK

BEEF CATTLE

Beef cattle provide a profitable way to use pasture, roughage and coarse grain. On many farms they are the major source of income. When crop rotation and good pasture management practices are followed, still greater revenue may be secured from them.

Selection of Beef Cattle.—Characteristics which should be considered when selecting breeding stock are: (a) Reproductive ability; (b) weight for age; (c) conformation; (d) milking ability; (e) hardiness; and (f) temperament.

Reproductive ability is a most important factor. The culling of slow and non-breeding animals should be carried on continuously. Proper attention to feeding, disease and condition of the feet is necessary to ensure high calving percentages. A calf crop of 90 to 100 per cent should be the aim of the beef producers.

Sire selection should receive special attention. With a young sire it is not always possible to stress breeding performance, however the performance of the bull plus the performance of near relatives must be considered. Older sires have a special value if their offspring have demonstrated outstanding performance.

Weight for age and rate of gain are important, as the fastest growing animals are usually the most economical to feed. Useful information concerning these factors may be obtained by weighing the calves at six months of age and again as yearlings. Detailed information on methods of performance testing in commercial beef herds and the official program for purebred beef herds is available through the Animal Industry Branch, Sask. Dept. of Agric., Regina.

Body conformation is important in providing a good carcass. A desirable beef animal is thickly fleshed, uniform in width and depth, smooth and fairly low set, with sound legs and feet. Either the extremely compact or rangy types of cattle should be avoided.

Milking ability of the beef cow herd is the most important factor in producing heavy weaning weights. Hardiness and quiet temperament are desirable traits both in breeding stock and feeder cattle.

Cross-breeding. — Cross-breeding, as opposed to pure breeding or the continued use of sires of a single breed in a "grading-up" program in commercial herds, has been shown to result in offspring that may be more profitable. Often the cross-bred female gives superior performance through better fertility, milk production and hardiness. It is emphasized that the quality of the individual sire used is at least as important as the breed used. The success of such a system depends upon the availability of outstanding bulls of the several pure breeds, and upon adherence to a **well-planned breeding program.**

Management of the Beef Breeding Herd.—Beef cattle do not require elaborate housing. Sheds of rough lumber, slabs or straw bales, open to the south are satisfactory, but special provision for sick animals and winter calving is necessary. Beef cattle should be bedded generously.

Only well developed beef heifers should be bred to calve at two years of age. They should be on good pasture during the nursing period and fed so as to gain a minimum of ½ pound per day during the winter. Replacement heifer calves should be calfhood vaccinated for control of Bang's disease. (See **Animal Diseases,** p. 157.)

Daily inspection of the cow herd during the calving period is necessary.

Calves should be castrated with a knife or emasculator. The Burdizzo is useful where an open wound may involve risk but operating instructions should be followed or incomplete castration may result.

Dehorning.—Spring and fall are the best seasons for dehorning. For calves up to two weeks old, dehorning pastes, liquids and electric dehorners are satisfactory and should be used according to instructions. When the horn growth is fairly strong, gougers are effective. Dehorning clippers are necessary for cattle of one year or more. Care should be taken to remove the horn as close to the skull as possible so unsightly stubs do not remain. Where there is danger from flies, pine tar or some coal tar product should be applied to the wound and cavity.

If cattle being fed sweet clover are to be dehorned or castrated, this feed should be removed from the ration for a period of a month prior to the operation to prevent danger of excessive bleeding.

Creep Feeding and Weaning.—Beef

calves are weaned at five to eight months of age. Many of the difficulties associated with weaning can be avoided by creep feeding the calves. When pastures fail or calves are sold at weaning or are put on full feed at weaning, creep feeding is especially profitable. Some simple type of feeder fenced in a manner to exclude cows but allowing the calves access is sufficient. The feed need only be whole oats or oats and barley unless the milk supply is very low when 1 part of a 32% protein supplement to 5 parts of grain is recommended.

When calves are weaned, it is an opportune time to cull out cows that are undesirable because of age, breeding record, disease or injury.

Herd Sires.—Beef bulls 15 months of age, under good management practices, can satisfactorily serve 15 to 20 cows in a breeding season. Older bulls can serve up to 50 or 60 cows when hand-mated. Range bulls can be expected to serve only 20 to 30 cows.

Regular daily exercise is important for breeding efficiency. The feet should be examined and trimmed when necessary (see Herd Sire, p. 130). Beef bulls should be kept in medium condition at all times. A green, leafy grass-legume mixture is an ideal roughage. When lower quality roughages are fed it may be necessary to supply additional Vitamin A, ground grain or protein supplement (see Bulletin 134). Water and a salt-mineral mixture should always be available.

Feeding the Beef Herd.—Rapid and economical growth is secured from good pasture. For suitable seeding mixtures and pasture management, see page 63. Cattle coming off pastures in a well fleshed condition will winter better than cattle in poor flesh. In the greater part of Northern Saskatchewan most native and tame grasses lose much of their nutritive value after a killing frost. Supplementary feeding at this time will avoid severe weight losses. Grass-legume hay or silage is the best roughage for winter feeding and in cases where supplementary feeds are necessary, coarse grains are all that is required.

Prairie hay, oat sheaves and cultivated grasses are commonly used. These feeds, while satisfactory, are somewhat lower in feeding value than grass-legume hays. Low quality roughages may require supplementation with grain, protein or Vitamin A (see Bulletin 134).

Attention to early cutting, proper curing and storage to afford the maximum retention of feed nutrients in all forage crops is extremely important. Further information on forage harvesting see page 68. Weathered and mature roughages and straw are low in Vitamin A. To produce a healthy calf crop such roughages, when fed to the breeding herd, should be supplemented with Vitamin A either as alfalfa meal (¼ to ½ pound/head/day depending upon quality) or as a beef supplement containing Vitamin A. Pelleted supplements are available for use on pasture.

Beef calves not nursing their dams should be fed the same as dairy calves (see Dairy Cattle, page 129). Young growing stock require protein and minerals in sufficient quantity for rapid growth. Stunted animals are rarely profitable.

The use of a tank heater for winter water supplies is recommended and results in better feed use.

Feeding for Market.—Whole oats is a recommended grain when feeder cattle are first placed on feed. Calves should be started on one pound of grain per head daily, yearlings and two-year-olds on two pounds per head daily. After the first week ground barley or wheat should be **gradually** increased. The animal in the feed lot is the best indicator of when to increase the amount of grain and the maximum amount to be fed. The daily allowance should be increased gradually. Fifteen pounds of grain per day is a practical maximum for fattening calves and from 20 to 25 pounds for older feeders.

Protein supplements are often highly beneficial when poor quality roughage constitutes ½ or more of the daily ration by weight. One half pound of a protein supplement will meet most deficiencies for yearlings or older cattle. Feeder calves will require from ½ to 1 pound of a protein supplement depending on the amount of grain being consumed and the quality of the roughage. With medium or low quality roughages it is advisable to feed additional Vitamin A in the form of alfalfa meal or in a commercial supplement.

The use of self-feeders in fattening will give faster gains and lower labor requirements but the greatest economy can be secured from skilled controlled feeding. Fattening calves require at least 200 days feeding and will consume 1800 to 2200 pounds of grain mixture and about 1000 pounds of dry roughage per head. Salt, a mineral mixture and water should always be available.

Hormone preparations either mixed in the feed or implanted in the ear of feeder cattle will increase the daily

gains when used according to directions. Implanted hormones will also improve gains of cattle fattening on pasture. Breeding stock must not receive these hormone preparations.

A good windbreak may provide most of the necessary shelter although a roof to keep snow off the backs of the cattle may be desirable. Ample bedding will increase feeding efficiency.

Marketing Beef Cattle.—Saskatchewan has a large potential for marketing finished cattle. Nearly one-half of the steers and heifers marketed are graded medium and common. Many of these are of suitable type to qualify for higher grades if they are carried to a higher degree of finish, which, in most cases, would provide higher returns to the feeder.

Top grades of beef (Canada Choice—Red Brand, Canada Good—Blue Brand and Canada Standard—Brown Brand) continue to find ready acceptance by consumers who seem willing to pay for quality. The aim should be to improve the average quality of cattle marketed.

ARTIFICIAL BREEDING

Artificial Breeding (A.I.).—During the period 1956-59 twelve co-operative A.I. breeding associations were organized in Saskatchewan and several ranchers adapted the technique to their operations. A.I. provides the opportunity of obtaining the services of superior sires without the need to maintain bulls on the farms. It is expected that A.I. breeding will increase among dairymen and commercial beef cattlemen. For further information see Bulletin 139, Facts About Artificial Breeding, and contact the Agricultural Representative.

DAIRY CATTLE

Maintaining a dairy herd as a major enterprise is a complicated operation and requires considerable specialized knowledge and managerial ability. Income is derived primarily from the sale of milk or butterfat, so access to a good market is important. Profits are influenced by the quality of cattle, their housing, regularity of breeding, success in raising replacement heifers, incidence of disease (especially mastitis), the feeding program and other factors.

Barns.—The dairy cow requires more elaborate winter housing than the beef cow. Most dairy herds are kept in closed, warm barns but good production can be obtained in loose-housing barns provided that the ventilation is designed to keep humidity low and to prevent wide fluctuations in temperature. Each type of housing has certain advantages and disadvantages. Loose-housing often involves lower initial cost, reduced labor during use and reduced mastitis. Conventional stanchion housing allows more individual care of each cow, the cows look better if the stalls are kept clean, less bedding is required, and the premises as a whole have a more attractive appearance. Dairymen contemplating new buildings should obtain further advice on designs best suited for their areas. Bulletins on Dairy Cattle Housing can be obtained from the Extension Dept., University of Saskatchewan, Agricultural Representatives, or Experimental Farms.

Selection.—Cattle of dairy type and breeding are recommended where dairying is an important farm enterprise. Cows should have good depth and width of chest, depth and spring of rib and exhibit heritable dairy potential through natural leanness and general angularity of body conformation. Udder should be capacious, well-balanced, of pliable texture with strong body attachments.

Preference in selection should be given to individuals having superior milk production and selective registration records.

Dairy Herd Improvement Services.—These policies are designed to encourage the improvement of dairy herds through regular testing and recording of milk and butterfat production. Under the Dairy Herd Improvement Association (D.H.I.A.), a Dairy Fieldman, employed by the Saskatchewan Department of Agriculture, tests and records the monthly milk and butterfat production of individual cows. Under the Cow Testing plan, the herd owner weighs and samples the milk from each cow two days a month and forwards the samples to an official testing centre. For further information, write to the Animal Industry Branch, Department of Agriculture, Regina.

Record of Performance (R.O.P.) is a service provided by the Federal Department for the recording of production on purebred cattle. For information, write to the Federal Livestock Division, 841 Motherwell Building, Regina.

Herd Replacements.—The dairy herd can be maintained either by the periodic purchase of cows or by raising heifer calves. Where a good sire is in use, the practice of raising and retaining suf-

ficient heifers from the best cows is recommended, since cows and heifers of the best type are difficult to buy.

Feeding for Production.—Production is of major economic importance for a successful dairy industry. The cow that produces 3,000 pounds of milk annually utilizes only one-quarter of her feed intake for producing milk, whereas the cow producing 8,000 to 10,000 pounds converts more than half her intake into milk. This cuts the feeding cost of producing milk nearly in half.

High producing dairy cows require generous feeding. Such cows require a balanced ration of roughage and/or silage, coarse grains, protein concentrates, and an adequate mineral and water supply.

The feeding of grass silage has, in many cases, made it possible for farmers to utilize their own coarse grains without supplementary protein along with a good quality of roughage to give dairy herds a satisfactory balanced ration.

A satisfactory rule in planning rations for dairy cattle is to feed roughage according to body weight and concentrates according to production. Dry roughage may be fed at the rate of 2 to 3 pounds per 100 pounds of the animal's liveweight. If available, 3 pounds of silage may replace each pound of hay. Concentrates should be fed at the rate of one pound for every 3 to 4 pounds of milk (depending on test) produced beyond 15 pounds daily. By this rule, a 1,200 pound cow giving 35 pounds of milk daily should receive 24 pounds or more of dry roughage and 5 to 7 pounds of grain mixture daily. Regular feeding hours and feeding habits are recommended. Individual attention of each animal is essential for highest production.

The roughage used determines the kind of concentrates necessary. Alfalfa and clover hays go very well with a mixture of cereal grains. Prairie hay, tame grass or oat sheaves require the addition of some high protein feed such as linseed oil meal, to the home grown grains. A mixture of ground farm grains, not too light in weight, 1/5 to 1/10 linseed oil meal or 32% protein supplement, depending on roughage quality, will be suitable. Succulence is not essential to the dairy ration but cows relish good silage and dried beet pulp and molasses may be used to advantage. Unless prices of the latter products correspond closely to those of farm grains used for feed, they will be most economically used in small amounts to stimulate appetite.

Many nutritional diseases are due to mineral deficiencies in the ration. (See Mineral Supplements.)

Grain for dairy cows should be coarsely ground or rolled. The grinding of the roughage is not necessary.

Further information on the feeding of dairy cattle is contained in University of Saskatchewan Agricultural Extension Bulletin No. 98, entitled "Dairy Cattle Production in Saskatchewan."

Care at Calving Time.—The dairy cow requires a dry period of 6 to 8 weeks to restore body reserves for the following lactation. During the last month of milking and the dry period the cow should be fed so as to ensure a strong, thrifty condition at calving time.

For winter calving, the cow should be placed in a clean, comfortable pen, with plenty of dry bedding 2 or 3 days before calving. At this time a bran mash should be given. At the time of calving, an attendant should be near to give assistance, if required. Sometimes a membrane will be found clinging to the nostrils of the calf; this should be removed quickly so that the calf can breathe freely. If the cow refuses to lick her calf after calving, the attendant should rub the calf vigorously with a dry sack. After calving it is advisable to avoid milking the cow dry for two or three days, or until danger of milk fever is past. When all is normal, her ration can be gradually increased so that she is on full feed in about two weeks.

Feeding Calves.—The first milk, or colostrum, being high in protein and mineral matter, and rich in Vitamin A, is necessary for the health and thriftiness of newborn calves. Vitamin A deficiency may lead to scours, colds, eye trouble, pneumonia, general unthriftiness and even death.

Following two or three days of colostrum feeding there are several alternatives: (1) feeding whole milk for two or three weeks along with a good, dry calf starter; (2) feeding skim milk fortified with a teaspoonful of feeding fish oil daily, along with starter or (3) feeding a milk replacer instead of whole or skim milk until the calf weighs about 150 pounds. The latter method has proven practical and most economical where fresh milk can be sold. See Bulletin 98, "Dairy Cattle Production in Saskatchewan."

From 6 to 10 pounds of mother's milk a day is a suitable allowance for the first 2 or 3 days. A daily ration of

milk equal to 10% of the calf's weight is a fairly reliable rule in feeding young calves up to 4 to 6 weeks of age. The stomach capacity of newborn calves is limited and overfeeding is a common cause of scours.

If skim milk is in short supply it will be necessary to use a good calf meal until the calves are 3 to 4 months of age. Commercial calf meals designed for young calves are available and will give good results if used according to recommendations. Only small amounts are needed but quality is important.

The calf which is allowed skim milk (up to a maximum of 15 to 20 pounds per day) until 6 to 7 months of age does not require complicated calf meals. In addition to skim milk, one should feed a mixture of oats (of good quality), bran and linseed oil meal in the proportions of 70 pounds oats, 15 pounds bran and 15 pounds linseed oil meal. Good quality roughage, preferably legume, should be fed. The feeding of grain mixtures and hays should begin as early as calves will eat them. Fresh water and a mineral mixture should be available to the calves at all times.

Scours in young calves is generally evidence of digestive troubles. Overfeeding is probably the most common cause but sour milk and dirty feed pails may also be causes. When scouring occurs, the amount of milk fed should be reduced to half or less and the volume made up with water.

Calfhood vaccination for the control of Bang's disease should be done when heifers are between 4 and 11 months old. For additional information, see Animal Diseases, page 158.

Age to Breed.—Because of variations due to feeding and mangement, it is recommended that size rather than age be used as a guide to ensure adequate development for the first calving. The following are the recommended breeding weights:

Jerseys	550 pounds
Guernseys	600 pounds
Ayrshires	650 pounds
Holsteins	750 pounds

These weights should be attained between 15 and 18 months of age.

Herd Sires.—Exercise is essential to the health, thrift and breeding ability of the herd sire. The sire's feet should be trimmed at least twice a year. The hoof should be trimmed from the under side so as to form a level bearing surface. When the outer edge is cracked or badly formed, trim the edge with pincers and a coarse rasp.

Good hay, and pasture in season, together with a typical dairy ration should be fed in amounts sufficient to keep the sire in medium flesh. Good water and access to salt and minerals should be provided. Improper care, management or feeding may result in very unsatisfactory breeding results from the sire.

HORSES

There is a place, even on most tractor farms, for a type of horse that can be used for farm work, winter driving and, on occasion, riding. A horse lighter than the draft breeds is likely to be the most useful. This type of horse may be obtained by crossing a stallion of one of the light breeds with draft mares.

Care of Brood Mares.—The in-foal mare needs little special feed or care until near foaling time, but should have daily exercise. Mares that foal before the pasture season should receive a grain ration to ensure a thrifty condition and a good milk supply. A mixture of oats and bran is very satisfactory. Roughages of good quality should be fed. The roughage ration in winter should be at least one-third legume hay. The oats should be decreased and the bran increased about a week before foaling. In addition to salt, the pregnant mare should receive one tablespoon potassium iodide solution (see section on Minerals) daily for at least the last three or four months of pregnancy to prevent weak foals that are more susceptible to infections of navel and joint-ills.

Care of Foals—It is essential that the foal be kept in clean surroundings. Assistance may be needed during foaling. It may be necessary to aid the foal in getting the first milk. The foal's navel should be disinfected with tincture of iodine or 2% carbolic acid in water. If the mare is well fed and has an adequate milk supply the foal will not need much care for the first few months. Most foals are weaned at five to six months of age. By this time the foals should be eating 2 - 3 pounds of grain a day, preferably oats. They should be given good legume hay and have access to fresh water.

The first winter is a critical period and feeds rich in protein, vitamins and minerals are needed. A suitable feed mixture consisting of 60 lbs. rolled oats and 30 lbs. bran and 10 lbs. linseed oil

meal, fed at the rate of one pound per hundred pounds of liveweight would be adequate. From 20% to 50% legume hay in the roughage will help to supply additional proteins and vitamins but access to minerals is advisable. (See section Minerals.) It is important that the growing colt get daily exercise.

The Working Horse.—During heavy work, the horse requires 1 to 1¼ pounds of roughage and one pound of grain daily for each 100 pounds liveweight. The feet should be kept trimmed and the teeth examined periodically.

SHEEP

Sheep raising in Saskatchewan falls into two general classes: Range flocks and Farm flocks. Where large range flocks are raised, sheep constitute the main source of income. Farm flocks are usually smaller in size and are a secondary enterprise.

Sheep can utilize summerfallow and stubble and are ideally suited to cheap, non-arable pasture lands. They are, of course, that much more profitable when grazed on good pastures. Revenue is obtained from both wool and lamb and where sound management practices are followed, sheep provide a good return to investment.

Equipment.—Elaborate equipment is not required for sheep raising. A woven wire fence is almost a necessity. While the original cost is high, it will pay over a period of years because of the labor which is saved.

Sheep suffer more from draughts and moisture than from low temperatures. Consequently, the only shelter required is protection from wind and moisture. A low shed of straw or frame construction, on high ground, no more than 20′ deep with openings on the south only and with a low-pitch, rainproof roof is all that is needed. Mature sheep require from 12 to 16 square feet of floor space per head exclusive of space for feed racks.

For early lambing, a more elaborate closed-in building will be required. However, for small flocks, a small area of the stable or similar building can be used for these short periods.

Breeding Stock.—Those who wish to start with purebreds can obtain their animals from established purebred breeders.

"Grading-up" is a breeding system involving the repeated use of rams of one breed and will in subsequent generations result in the production of lambs characteristic of the breed of sire used. Mutton-type rams of such breeds as Suffolk, Hampshire, etc. have produced good market lambs when used in this way.

Crossbreeding has been shown to impart hybrid vigour to the offspring, resulting in more rapid and efficient growth. Where replacement females can be purchased at reasonable prices, a producer could sell all crossbred offspring and use the same ram as long as he is breeding satisfactorily. As crossbred females are usually more prolific and better milkers than their straightbred counterparts, crossbred ewe-lambs could be grown out and bred to a ram of a third breed. All lambs from this cross should be marketed.

One of the least expensive sources of satisfactory breeding stock for the commercial producer, is the surplus ewe lambs and older mature ewes from range bands. These ewes are hardy, long-lived sheep which give heavy fleeces of high quality. They flock well and are capable of raising good lambs on relatively poor pastures. While they are lacking in mutton conformation, mating them to a ram of one of the "down" breeds, such as Hampshire, Suffolk, Southdown or Shropshire, results in good market lambs.

Yearling ewes are usually the best buy because they are ready to produce the first year and have their full productive life ahead of them. However, if the price is low enough, sometimes it is advisable to buy older ewes provided they are sound in mouth and udder. Whatever the age of the ewes bought, they should be uniform in size, fleece type, conformation and breeding to ensure uniformity in the lamb crop.

Management.—For approximately one month before breeding, the ewes should be given extra feed of high quality. This is called "flushing" and has a tendency to increase the number of multiple births. Flushing can best be done by feeding approximately 1 pound of grain per ewe per day. The ram should also receive some grain, preferably oats, at this time to prepare him for the breeding season.

The gestation period is approximately 145 days. Unless adequate shelter is available, it is best not to start lambing until danger of severe cold or stormy weather is over. A yearling or mature ram will breed up to 40-50 ewes per

season, while a ram lamb can breed about 20 ewes. In large range flocks the general practice is to use three rams per 100 ewes and run them all together. To be sure that a ram is breeding satisfactorily, lamp black or ocre or a ewe-marking harness can be used on the chest of the ram so that each ewe bred is marked. Changing the color at 17-day intervals will show which ewes are being rebred. If many ewes are returning, a new ram must be obtained immediately.

During the winter the flock should have sufficient exercise to ensure good health. Undue exertion such as plunging in deep snow should be avoided.

About one month prior to lambing, it is advisable to feed ½-1 pound of oats or other farm grain per ewe per day to ensure strong lambs and a good milk flow. Some time during the last two weeks before lambing is due to start, it is advisable to "crutch" the ewes. This consists of trimming off the wool around the udder and lower rump. This practice saves labor during lambing and shearing and prevents young lambs from swallowing tags, which result in digestive troubles.

If the weather is mild, probably the best place to lamb is on a clean paddock or pasture. However, in most instances, lambing can best be carried out when the ewes are confined, for ease of checking the flock. In some instances, it may be necessary to help the new born lambs take their first feed. As a precaution against disease, it is a good practice to dip the navel cord of the new born lamb in a tincture of iodine solution.

The ewe and lamb should be confined to a 4′ x 4′ "claiming pen" until the lamb is nursing satisfactorily. While in these pens the ewe should have access to roughage at all times and water at least twice a day. After the lamb has nursed a few times and is strong enough to follow its mother, the ewes which have lambed can be penned together. They should be turned out to grass just as soon as pasture and weather conditions will permit. Except for the provision of water, good pasture and ample supplies of mineral, the flock requires very little attention during the summer. (See Mineral Supplements.)

All the lambs should be docked and the males castrated at about 10 days to 3 weeks of age since "buck" lambs are discounted in the slaughter trade.

Native grass is an excellent pasture for sheep. Cultivated grasses are usually more productive and consequently more sheep can be raised per unit of land.

Faster growth and more finish can be obtained by creep feeding the lambs as soon as they show interest in solid feed. The creep consists of an enclosure, the entrance to which is large enough to permit only the lambs to enter. Whole oats is the best grain to feed in the creep. Either a self-feeder or troughs can be used to hold the grain.

The lambs can be weaned at about five months of age.

Feeding Market Lambs.—Lambs may be marketed as slaughter or feeder stock. For best grades and prices, lambs should weigh between 80 and 100 pounds at slaughter and be carrying a desirable but not excessive finish. Early lambs can be brought to this condition before weaning if on good pasture and liberal creep feed. Later and lighter lambs can either be sold as feeders or put into a feedlot for finishing before marketing.

If lambs have been accustomed to grain through creep feeding, they can usually be started at one pound of grain per lamb per day. If they have not been creep-fed, then they should be started at ¼ pound of grain, preferably oats, per day per lamb. This should be increased as speedily as possible without causing digestive disturbances until they reach full feed which usually is about two pounds per day. As the feeding period progresses, the heavier grains, such as barley and wheat, can gradually be introduced until they make up the entire grain portion of the ration. There is no advantage in grinding grain for sheep.

The roughage portion of the ration should be good quality hay. Either native or cultivated grass hays are satisfactory. If at all possible, one-third to one-half of the roughage should be good quality legume hay. If this is not available, ¼ pound of linseed oil meal or other protein supplements per lamb per day will increase rate of gain and feed efficiency.

A salt-mineral mixture should be available at all times and the lambs should have access to water at least twice a day.

See **Animal Diseases**, page 163, regarding prevention of "over-eating disease" (enterotoxemia).

Shearing.—Wool is a valuable source of income from the sheep enterprise. Shearing should be done during the first half of June. Care must be taken to keep the wool in good condition to ensure top market price. Shearing schools

may be organized by the Agricultural Representative in areas where groups show interest in doing their own shearing.

The following points should be carefully watched: (a) shear only on a clean floor; (b) shear in a manner that keeps the fleece in one piece and avoid second cuts; (c) keep the wool free from dirt or vegetable matter; (d) spread the fleece flesh side down on slatted table 4′ x 8′ and about 3′ high; (e) remove all tags, leg and face clippings, burry or chaffy bellies and neck pieces (these are then packed separately); (f) fold the fleece in from the sides one side overlapping the other, roll tightly from the breech to shoulder end and tie with a paper string; (g) pack tightly in proper wool sacks obtainable from wool handling companies.

Predators.—Losses caused by coyotes and dogs have been severe enough to cause many farmers to give up raising sheep. However, where the coyote control program has been carried out by the Provincial Government and the rural municipalities, the coyote menace is no longer a problem.

The sheep breeder is afforded some protection from losses by dogs by the Sheep Protection and Dog Licensing Act. All breeders should be familiar with this and other acts, copies of which may be seen in municipal offices.

Additional Information. — Bulletins, building plans for housing and equipment, etc. are available from Extension Department, University of Saskatchewan; Agricultural Representatives or Federal Experimental Farms.

Bulletins entitled Breeding for Market Lamb Production, Publ. 864; Feeding for Market Lamb Production, Publ. 872; Shepherd's Calendar, Publ. 873; Sheep Diseases in Canada, Publ. 904 and Breeds of Sheep and Their Uses in Canada, Publ. 1031 can be obtained from Information Service, Canada Department of Agriculture, Ottawa.

Information on the Purebred Ram Grading Policy can be obtained from the Federal Livestock Division, 841 Motherwell Building, Regina.

For information on the Purebred Ram Purchase Policy, contact the Agricultural Representative or the Animal Industry Branch, Saskatchewan Department of Agriculture, Regina.

For sources of Breeding Stock, write Saskatchewan Sheep Breeders' Association, Exhibition Grounds, Regina; Southern Saskatchewan Wool Growers' Association, c/o G. S. Herringer, Maple Creek; Federal Livestock Division, 841 Motherwell Building, Regina, or Animal Industry Branch, Saskatchewan Department of Agriculture, Regina. See also **Mineral Supplements, External Parasites, Internal Parasites, Animal Diseases,** and **Services Available.**

SWINE

The producer who raises hogs year after year and makes slight adjustments in volume to offset expected gluts or scarcities usually succeeds in the hog business. With a basic breeding herd, he is in a position to increase or decrease the production of market hogs.

A permanent program of pig production should be related carefully to dependability and adequacy of feed and water supplies.

Housing.—Much of the success in hog raising depends on well planned housing. Movable colony houses serve well for summer housing of brood sows and, during winter, these may be covered with straw. Satisfactory temporary winter housing for sows can be constructed with baled straw for walls and with straw over wire, poles or slabs for the roof. Such structures will be warmer if the doors face south and if the ceiling is kept reasonably low. A ventilator extending nearly to the floor should be placed at the rear of the house. Ample bedding should be provided.

Brood sows should be fed some distance from the sleeping quarters to provide the exercise necessary for the production of strong, vigorous litters.

For economical hog production on a year-round basis, a permanent type of housing is essential. Better disease and parasite control is possible when farrowing quarters are separated from other swine housing. Pens should be arranged to accommodate either farrowing sows or feeder pigs in such a way as to facilitate feeding and management practices. The building should provide adequate storage for feed and bedding, be well insulated and ventilated and be provided with a source of heat.

Floor area requirements range from 3 to 10 sq. ft. for weanlings to 200 lb. pigs respectively; dry sows, 20-35 sq. ft.; sows with litters 50-80 sq. ft.

Plans for housing can be obtained. (See **Additional Information** section.)

Selection of Breeding Stock.—Only boars of pure breeding and good bacon type should be used. The Yorkshire

breed is the most popular but Lacombe and Landrace pigs are attracting interest. Selection of a breed or an individual should be based upon proven quality of carcass and performance. Official testing of breeding stock for size and soundness of litter, rate of growth and carcass quality is done by the Canada Department of Agriculture and is known as "Record of Performance" (R.O.P.). The Test Station in Saskatchewan is located at the University. The offspring from animals having above-average scores in carcass, rate of gain and feed efficiency represent the best stock for the production of bacon pigs. In selecting breeding stock, attention should be given to smoothness of shoulder, length and depth of side, and development of ham. Gilts selected for breeding should be from prolific, rapid growing, high grading strains and should have at least 12 normal teats. Sows and boars from litters in which hermaphrodite (intersex), cryptorchid (ridgling) or ruptured pigs have occurred should not be kept for breeding. Special attention should also be given to the question of diseases, especially when purchasing stock.

Breeding.—The gestation period in pigs is about 114 days. Where suitable accommodation is available, the farrowing season should be extended and, under favorable conditions, fall farrowing as well as spring farrowing should be practised.

Cross-Breeding. — A well-planned cross-breeding program involving high quality individuals of two or more breeds offer certain advantages to some commercial producers. Larger, more vigorous litters and faster growth rates are typical of first-cross progeny. Cross-bred females make excellent brood sows. The success of a cross-breeding venture depends upon adherence to a planned mating system. Advice should be sought from the Livestock Specialists.

Care of Brood Sow.—The feeding program during pregnancy is extremely important for the production of strong pigs and good milk supply. Grains fed to pregnant sows require supplementing with extra protein, minerals and vitamins in order to prevent nutritional deficiencies.

A mixture of equal parts of oats and barley or oats and wheat is satisfactory for sows, if it is coarsely ground and properly supplemented. For sows that are self-fed, this mixture should contain alfalfa meal, bran or light weight oats to prevent excessive fattening.

Protein in the ration may be maintained at the best level during pregnancy by using 1½ pints of skim milk or buttermilk per pound of grain or 7% to 8% of a good mixed protein supplement.

Calcium should be provided by liberal use of skim milk, buttermilk, protein-mineral supplements or 1% ground limestone in the ration.

Vitamins may be provided by using some alfalfa hay of good quality as a supplement. This hay may be placed in racks or on the ground for the sows to take as they choose or included in the grain ration as dehydrated alfalfa meal at the rate of 5% to 10% by weight. Without alfalfa hay, a tablespoon daily of Feeding Fish Oil or Vitamin Feeding Oil is recommended. Lack of Vitamin A results in small, weak or blind pigs. During pergnancy each sow should be given a tablespoonful daily of a solution consisting of one ounce of potassium iodide in a gallon of soft water to prevent hairlessness and goitre in newborn pigs.

Good quality, seeded pasture, in season, supplies most of the extra vitamins, minerals and protein needed by pregnant or dry sows, so little if any supplement need be added to the grain.

Farrowing and Nursing.—Special attention at farrowing time usually reduces mortality of young pigs. The farrowing pen should be clean and equipped with a guard rail to prevent crushing of the young pigs by the sow. It is advisable to use short straw for bedding and to use it sparingly so as to avoid interference with the movement of the small pigs. If the temporary tusks of the young pigs interfere with nursing they should be nipped off with small sharp side-cutting tooth nippers.

A brooder can be easily and cheaply built by nailing a strong 3-foot high, 6-foot long partition of three 2" x 8's" across the corner of the pen. An 8-inch space is left at the floor and fitted with a top-hinged door. A 250-watt heat lamp covered with a screen (fire precaution) is suspended over the brooder area at least 18" from the floor or bedding. A 150-watt bulb may be substituted as the heat requirements of the pigs decline. The heat at the floor can be adjusted by changing the height of the lamp. Pigs that are comfortable do not pile up. Three weeks is generally long enough to use the lamp but in very cold weather an extra week may be desirable. A brooder is also useful for a creep since the sow is prevented from entering the corner.

A farrowing crate is a highly recommended means of providing warm and reasonably safe accommodation for the young litter. Plans for farrowing crates are available. (See Additional Information.)

A sow may be encouraged to adopt strange pigs if they and the sow's own pigs are given a mild creolin odor or if the strange pigs are rubbed with the sow's pigs to acquire an odor familiar to the sow.

Light, laxative and sloppy rations containing about 25 per cent bran are best for the brood sow at farrowing time. Several days should elapse after farrowing before she is brought to full feed but generous feeding is important thereafter if she is to nurse a large litter. For nursing sows a grain ration composed of two parts ground wheat or ground barley and one part ground oats would be appropriate with abundant skim milk or 15 per cent of a protein-mineral supplement.

To prevent anemia, pigs raised indoors should be treated with one of the injectable iron preparations, according to manufacturer's directions, or with ⅛ teaspoonful of ferrous sulphate or reduced iron at 2, 9, 16 and 23 days of age. Administering a squirt of Vitamin A and D feeding oil from a plunger-type oil can along with the iron treatment is recommended. The oil forms a paste with the iron, preventing inhalation of the powder into the lungs and at the same time supplying Vitamins A and D to keep the pig's disease resistance high.

Suckling pigs should be encouraged to eat solid feed as soon as possible to supplement the sow's milk and reduce the drain on the sow as well as to encourage even development. A sweetened commercial creep feed should be made available at from one to two weeks of age. To encourage consumption of solid feed, suckling pigs should have access to a supply of fresh water. Once pigs are eating well, regular pig starter should be used. Since commercial feeds contain antibiotics they are to be recommended over home-prepared starters. If skim milk is available, it may be used along with ground, de-hulled oats as a home-made supplement to sow's milk. Care should be exercised in keeping utensils clean and the feed fresh.

Pigs should be weaned at from 6 to 8 weeks of age depending upon the sow's ability to feed them. Weaning at six weeks is necessary to allow better recovery of the sow before breeding when two litters are farrowed yearly. Weaning earlier than six weeks is possible but is not believed generally practical under average farm conditions. Male pigs not intended for breeding should be castrated at least a week before weaning time.

When a sow has insufficient milk to nurse her litter it may be necessary to use a milk substitute. (See Milk Substitutes.)

Growing and Finishing for Market.—Healthy, well-managed pigs require about 3.5 to 4.0 lb. feed per lb. gain between weaning and marketing. Diseases, poor housing or poorly balanced rations may greatly increase feed requirements and reduce profits.

Following weaning until reaching 125 pounds in weight, pigs require a low fibre, high protein ration. Grain mixtures fed during this stage of growth may be made up largely of barley or wheat or a combination of both. Oats may be fed but it should be limited if economically feasible. As the pigs grow, the grain portion of the ration is gradually changed to good quality feed oats. If wheat and barley are fed, part of the grain should be changed for light oats, alfalfa meal or bran to decrease the fattening value of the ration. The idea behind this feeding schedule is to force the pig to make rapid gains until reaching a weight of 125 pounds and then to reduce the rate of gain during the finishing period. This system has been found to improve carcass quality.

When skim milk or buttermilk is available, it may be fed at the rate of 2 pounds per pound of grain during the growing period and be gradually reduced to 1 pound per pound of grain during the finishing period. Skim milk contains no Vitamin A or D. One teaspoonful of fish oil or its equivalent must be fed per head per day. If these milk by-products are not available, a 35% protein supplement should be fed at the rate of 12% to 15% of the ration from weaning until 125 pounds, after which the protein supplement should be reduced to 6% of the ration until market weight is reached. It is extremely important to use a suitable protein-mineral-vitamin supplement for growing hogs. Good commercial supplements are available and formulas for home-made supplements may be obtained from bulletins on swine production. When commercial 35% protein supplements are used properly there is no need to add additional salt or minerals. (See Mineral Supplements.)

An antibiotic supplement may be fed to provide from 10 to 20 grams of antibiotic per ton of ration during the growing period, the higher level being fed to runty-poor-doing pigs. The amount of antibiotic may be cut in half during the finishing period or eliminated entirely, depending on the kind of ration and the type of pig being fed. (See Antibiotics in Feeds.)

Good quality seeded pasture, if limited, should be reserved for brood sows. However, if available for feeder pigs, it will provide much of the protein, vitamins and minerals required and reduce grain consumption. Gains on good pasture, while usually cheaper, are also generally somewhat lower. Two or preferably three pasture areas should be used in annual rotation to reduce disease and parasite infestation. (Round worm eggs may live over winter.)

It is important that pigs receive plenty of water at all seasons. A large water tank, equipped with a heater for winter use, and recessed automatic waterers, is recommended where large numbers of pigs are fed together. Several types of self-waterers suitable for use in indoor pens are now available. Their use will save considerable labor and will assure a continuous fresh supply of water at all times.

Pigs marketed between 180 and 210 pounds alive should yield carcasses within the weight range for grade A's. Shipping the thicker types at 180 pounds should result in better grades. Since excessive fat is an important factor in causing low grades and higher feed costs to the producer, special attention to this factor can improve grades and increase returns. The producer should receive a rail grade settlement for every hog shipped and should make use of the information thereon to determine causes for low grades and to identify superior strains. If, for example, his pigs graded down due to over-finish (F+), then feeding practices should be revised. If the pigs were graded down for type (T), then serious consideration should be given to obtaining breeding stock of better bacon type.

The Self-Feeder.—The self-feeder saves labor and can be used successfully in feeding market pigs. Experiments show an increase in daily gain over hand feeding but this is partly offset by an increase in feed used per pound of gain. Self-feeders should be carefuly constructed and be provided with a baffle or sliding panel which must be kept adjusted, depending on the texture of the feed, if wastage is to be reduced. Plans for self-feeders may be obtained. (See Additional Information.)

Sanitation.—Cleanliness in housing conditions is essential and should be the keynote of all swine raising operations. It is especially important that young pigs be kept out of pens or yards which may carry disease or the eggs of parasites. If pigs are allowed to run over the same ground year after year, heavy losses from parasites and disease may follow unless ploughing is done annually.

Treatment for Round Worms.—The main internal parasite affecting swine is the common round worm or ascarid. If a young pig in the first two or three months is weakened by any factor, such as poor feeding, anemia, vitamin deficiencies or excessive cold, or was born a weakling or runt, it may be highly susceptible to round worm infestation.

Heavy infestations of round worms cause coughing and in some cases severe pneumonia. This is followed by heavy and harmful infestation of round worms in the intestine. It is impossible to cure young pigs at the stage when coughing or pneumonia is present. Pigs from 90 to 170 days of age should be treated for the removal of the worms. Treatment should be accompanied by careful sanitation to prevent re-infestation and a second treatment in 60 days may be needed.

Two drugs which have recently become available are piperazine and hygromycin. Piperazine is very effective; of low toxicity to the pig and is used in one-day treatments. For additional control methods see **Animal Diseases**, page 162.

Additional Information. — Production and management bulletins, building plans, information on policies, etc., can be obtained from the Extension Department, University of Saskatchewan, Agricultural Representatives, or Experimental Farms. Information on **Record of Performance of Swine** can be obtained from Federal Livestock Division, 841 Motherwell Building, Regina.

SPECIAL FEEDING PROBLEMS

Illness, unthriftiness and mortality in livestock may be due in some cases to toxic materials in the feed or drinking water or to the fact that animals had access to poisonous substances. The following include the most commonly oc-

curring problems in this province.

Ergot.—Grain samples containing more than one ergot body per thousand kernels are regarded as toxic. Ergot causes abortion and may result in irritation and pain in the feet, tail, ears, etc. Dry gangrene may cause the loss of some body extremities.

Infested hay or pasture should also be regarded as dangerous. (See Additional Information below.)

Smutty, Rusted, Sprouted, Fire-Damaged, Moldy, Heated or Frozen Grains—Grains damaged by any of these factors have reduced palatability and feeding value but seldom are toxic to livestock. They are often used most satisfactorily in mixtures with sound grain. (See Additional Information, below.)

Nitrate Poisoning.—Under some conditions, not yet well understood, nitrates (salt petre) accumulate in growing plants. Forage containing more than 1.5% nitrates are considered toxic. Only cattle and sheep appear to be affected. Oat forage is most often involved but wheat and barley straws and certain weeds are sometimes toxic. Death is due to interference with the transport of oxygen by the blood. Death losses are often heavy but intravenous injection of methylene blue is effective in early stages of toxicity. (See **Animal Diseases** section.)

Frost, drought and weed sprays may be involved in the increased uptake of nitrates by plants.

Prussic Acid or Hydrocyanic Acid Poisoning.—Flax that has been frozen or severely affected by drought may contain toxic quantities of prussic acid. Amounts in excess of about 0.025% of the dry material (either forage or seeds) are dangerous to feed. Treatment by a veterinarian is possible only in the early stages. Death is likely to occur too quickly to allow for treatment. Suspicious samples should be analyzed before feeding is considered.

Water.—Poor quality water is sometimes the cause of difficulty in raising livestock. Water containing 0.35% nitrates (see **Nitrate Poisoning**) is toxic to cattle. Water high in alkali salts may cause unthriftiness due to interference with mineral nutrition. Water containing more than 5000 p.p.m. (parts per million) solids is considered to be of inferior quality.

Water contaminated by filth should not be used.

Blue-Green Algae.—Algae occasionally reach sufficient concentration in dugouts, lakes or sloughs to poison livestock drinking the water. Algae can be controlled by uniform application of copper sulphate (bluestone) to provide a concentration of 1 part per million of water. In dug-outs use about 2 lb. bluestone per 1000 sq. ft. bottom area.

Dicoumarol, "Sweet Clover Disease".—Improperly cured sweetclover hay or silage may mold and become toxic to livestock. Such damaged feed should be fed only occasionally or in limited quantities along with good roughage. Excessive bleeding from small wounds results from this type of feed.

Insecticides.—Certain insect sprays and powders are toxic to livestock.

Weed Sprays.—All manufacturers' warnings regarding toxicity to livestock should be carefully observed.

Grease and Oil.—Many of the modern lubricants contain toxic components (chlorinated naphthalenes), hence care is needed to prevent them from getting into feeds through grinders, etc., and to prevent livestock from licking machinery. A chronic, wasting illness of cattle is believed due to this cause.

Poisonous Plants.—Death losses from poisonous plants occur occasionally. It is advisable to become familiar with the local problems. (See Additional Information, below.)

Weed Seeds.—Feeds containing much mustard seed, lamb's quarters, pig weed, rape seed, stink weed, etc., have low feeding value. Some "black weed seeds" are actually injurious to livestock so it is not advisable to regard such material as useful feed.

Additional Information.—The bulletin entitled **The Problems of Ergot in Seed and Feed** may be obtained from Extension Department, University of Saskatchewan; Agricultural Representatives or Experimental Farms.

The bulletins entitled **The Feeding Value of Damaged Grain**, Publ. 914, and **Poisonous Plants of the Canadian Prairies**, Publ. 900, can be obtained from Information Service, Canada Department of Agriculture, Ottawa.

SUMMER FEED REQUIREMENTS

See **Forage Crops**, page 62, for carrying capacities of native and cultivated pastures and see information on feeding of the particular class of livestock involved.

WINTER FEED REQUIREMENTS

(All calculations are based on good quality grain, medium quality roughage and average production for the particular class of livestock.)

Class of Livestock	Period	Feed
Finishing Calves	200 days on full feed	1800 to 2200 pounds of a grain mixture, plus 1000 pounds of roughage.
Finished Yearlings	150 days on full feed	2000 to 2500 pounds of a grain mixture, plus 1000 to 1500 pounds of roughage.
Wintering Beef Cows	7 months	4000 pounds of roughage.
Winter Beef Calves	7 months	3000 pounds of roughage, plus 600 pounds of a grain mixture.
Producing Dairy Cow (9000 pounds of 4% milk)	7 months	6000 pounds of roughage, plus 2000 pounds of a protein supplemented grain mixture.
Market Hog (from weaning to market weight)	4-5 months	600 pounds of a grain mixture, plus 100 pounds of 32% protein supplement.
Finishing Lambs (from 50 pounds to a 90-pound market weight)	120 days on full feed	150 pounds of a grain mixture, plus 100 pounds of roughage.
Wintering Ewes	6 months wintering plus 1 month flushing	700 pounds of roughage, plus 30 pounds of grain, plus 6 weeks grain feeding before lambing at 1 lb./day/head.

WATER REQUIREMENTS

The livestock enterprise is dependent upon adequate water supplies. An animal's water requirement is closely related to feed intake but is influenced by such factors as moisture content of the feed, atmospheric temperature, mineral intake, etc. The approximate daily water requirement, in gallons, under average conditions are: dairy cow 12-15, beef steer 10, ewe 1-1½, horse 10-12, 100 lb. pig 2, lactating sow 5-6.

MINERAL SUPPLEMENTS

Only a few minerals are likely to be required to supplement the minerals ordinarily contained in farm rations.

Salt is always required. Cattle, sheep and horses should have access to it at all times. It may be included in grain rations for these animals and swine at the rate of ½ to 1 per cent.

Calcium and phosphorus are needed especially by growing animals and by females during lactation. If legume forage is being used the calcium needs are likely to be met for cattle, sheep and horses. Protein supplements, especially those of animal origin, grain and wheat bran contain more phosphorus than do hays. In general, however, for satisfactory growth and reproduction, extra calcium and phosphorus should be available. Cattle may be given access to bone meal alone, mixed with salt or added as 1 per cent of the grain mixtures. When legumes are not fed, dairy cows should also receive ½ to 1 per cent ground limestone with grain to supply calcium. Some of the calcium and phosphorus needs of the pig will be met if either skim milk, buttermilk, tankage or meat and bone scraps are fed in amounts recommended to meet the protein needs but a further allowance of bone meal and ground limestone will ensure better development for young pigs. (See Table, page 139.)

Iodine is needed particularly by pregnant and lactating females. A deficiency leads to the birth of hairless pigs, goitre in newborn calves and lambs and weak foals. It is not present in adequate amounts in feeds grown in Saskatchewan. It is, therefore, recommended that iodized salt, (see section on cobalt below) be used in preference to plain white salt. Iodine in iodized salt is "stabilized," yet much of it will be lost in a few months of exposure so it is advisable to provide new supplies frequently. As an added precaution, preg-

nant mares and sows should be given a tablespoonful of potassium iodide in one gallon of soft water.

Cobalt may be deficient in certain areas. Lack of it appears to affect only cattle and sheep. Animals affected appear unthrifty in spite of adequate feed intakes and proper supplies of protein, salt, calcium and phosphorus. The use of cobalt-iodized (blue) salt is generally recommended for cattle and sheep.

Iron (and copper) are usually abundant in average farm feeds but may be inadequate for sucklings. See instructions for giving iron to baby pigs.

Parakeratosis, a mange-like skin condition of growing pigs, appears to be a result of faulty mineral nutrition. The addition of zinc sulphate to the ration is recommended as a preventative. The level required is about ⅓ ounce per 100 pounds of complete feed or about 2 ounces per 100 pounds of protein-mineral supplement. Many commercial hog supplements now contain the necessary zinc.

While all the above minerals are available in commercial mineral feeds and in certain protein-mineral supplements, the mixtures listed below will supply the needs of farm animals. It is advisable to self-feed minerals to cattle, sheep and horses. Swine may be self-fed minerals but prepared protein-mineral (minimum 32% protein) supplements, used according to directions, will ensure better nutrition.

MINERAL MIXTURES FOR FARM LIVESTOCK

Mineral	Swine lb.	Beef, Dairy Cattle Sheep and Horses lb.
Bone meal, dicalcium phosphate or defluorinated rock phosphate	25	65
Ground limestone	50	5
Iodized salt	25	....
Cobalt-iodized salt	....	30
Ferrous (iron) sulphate	0.5	....

Recommended use: (a) 3% in rations for pigs up to 100 lbs. 3% in grain rations and free access in a box;
(b) 1½% for pigs 100-200 lbs.;
(c) 2% for pregnant sows.

ANTIBIOTICS

Antibiotics such as aureomycin, terramycin, penicillin, streptomycin, etc., are available in **Antibiotic Feed Supplements.** Many of the commercial protein supplements and complete mixed feeds for young pigs, calves, chicks and broilers contain appropriate kinds and levels of antibiotics. The feeding of antibiotics to these classes of livestock and poultry increase rate of gain, improves feed efficiency and eliminates or reduces digestive disturbances such as scours or diarrhoea. The use of antibiotics does not eliminate the need for proper sanitation and feeding practices. Antibiotics should not be fed indiscriminately, since resistant strains of bacteria may develop. It is best to confine use of these substances to rations for young animals, and situations such as scours where their use is specifically indicated.

Where antibiotic supplements are to be mixed on the farm it is advisable to obtain up-to-date recommendations on the kinds and levels to be used. Variations in potencies of products available and variations between classes of livestock make it difficult to provide general recommendations.

The reader is referred to the section on animal diseases for information regarding treatment levels of antibiotics.

VITAMIN SUPPLEMENTS

A wide variety of vitamin supplements is available. While animals do require ten or more different vitamins, it is often unnecessary to add vitamins to the ration. Exceptions include the feeding of low quality roughage to cattle, sheep and horses, where vitamin A may be lacking, or the feeding of pigs, since grain contains virtually no vitamin A or vitamin D. Ruminants can produce all the B-vitamins they require in the rumen, if the diet is normal with respect to protein, minerals and energy.

Vitamin preparations vary considerably in cost and complexity. It is important that feeding practices be based on the recommendations given above for each particular class of livestock and that appropriate vitamin supplements, as such, be included only where specifically indicated.

MILK SUBSTITUTES

Difficulties and losses in raising young animals may result from improper formulation, overfeeding, failure to feed colostrum (mother's first milk) for a day or two, or the use of dirty equipment. Access to fresh water is very important.

Calves.—Dairy calves and orphan beef calves often must be raised where whole or skim milk is not available. In such cases, commercial calf milk replacers or substitutes may be worthwhile. These contain dried milk by-products and various low-fibre feedstuffs, together with supplementary minerals, vitamins and antibiotics. After mixing about one part to eight parts of warm water the fluid is fed as milk at rates gradually increasing up to 15 pounds (1½ gal.) per day. Provided the price per pound, as purchased, does not exceed the farm value of about 2 quarts of milk, the use of milk replacers should prove economical for fluid milk shippers. Calves should be "weaned" gradually when about six weeks of age after becoming accustomed to a good calf meal, good quality hay and fresh water. It may be necessary to remove the drinking water for a while after feeding milk to prevent calves from drinking too much liquid at one time. For early weaning the feeding of a good quality commercial calf meal may be advisable until the calf is 3 or 4 months old at which time a simpler mixture will be adequate. (See Feeding Calves, page 129.)

Pigs.—It is essential that pigs receive colostrum during the first day. Sow's milk is rich in protein and fat. A tablespoonful of milk powder added per pint of cow's milk will produce a satisfactory milk substitute. This should be fed warm 5 or 6 times daily, a few ounces at a time. Pigs will soon learn to use a pan or fountain as well as a bottle. Ferrous sulphate should be feed (see page 135) and a teaspoonful of vitamin A and D oil should be given weekly. Commercial pig milk replacers, based essentially on milk by-products and well fortified with vitamins, minerals and antibiotics are to be recommended where a number of pigs are to be raised artificially. Frequent, thorough cleaning of troughs, waterers, etc. is extremely important. Regardless of the milk substitute used the pigs should be "weaned" onto a good starter and water at an early age, at least by 6-8 weeks.

Lambs.—Ewes milk is slightly richer in protein, fat and minerals than cow's milk. Add 1 to 2 teaspoonsful of milk powder per pint of cow's milk and bottle-feed about 1 to 2 ounces every 2 hours for the first day, at body temperature. A commercial calf milk substitute would probably perform satisfactorily. Gradually reduce the number of feedings per day and provide access to green grass, whole oats and water. Feed one teaspoonful of vitamin A and D oil weekly until lamb is on green grass.

Foals.—Mare's milk is rich in sugar but low in fat, protein and minerals. The addition of ¼ pint of limewater and 1 teaspoonful of sugar per pint of cow's milk makes a good substitute. Feed about ½ pint every hour for the first week and gradually decrease feedings to 4 times daily by six weeks. Allow one gallon of fluid per 100 pounds of liveweight daily. If a commercial calf milk replacer is used add ⅓ more water than required for calves. Provide access to pasture, minerals, a grain mixture (50 parts oat chop, 40 parts bran, 10 parts linseed oil meal) and fresh water. Feed by bottle at first but teach foal to drink from a pail as soon as possible. Give a tablespoonful of vitamin A and D oil daily.

(Limewater—shake a cupful of slaked lime in a gallon of water. Allow to settle several hours, then use the clear liquid above the residue in the bottom of the container.)

DAIRY PRODUCTS

Saskatchewan's dairy industry produces annually approximately 1¼ billion pounds of milk. Roughly one-quarter of the total is sold as fresh fluid milk and cream, one-half is used in the annual manufacture of about 30 million pounds of creamery butter and 2 million gallons of ice cream while one-quarter is consumed in farm homes either as milk or dairy butter.

Milk for fluid sale is produced on about 1500 farms located fairly close to their urban markets and on which dairying is an important, if not a major, enterprise. On the other hand, much of the cream for buttermaking comes from farms where a few cows are kept to supply the farm home with milk and meat, the surplus milk being marketed as cream. Dairy plants report about 40,000 such cream suppliers in the province and it is estimated that their herds contain approximately 200,000 cows. To the present time, manufacture of cheese or concentrated milk products has shown little sustained development in the province.

The domestic market is of prime importance to Saskatchewan dairy producers since virtually all fluid products and ice cream as well as more than half the creamery butter manufactured in the province is consumed here. Surplus creamery butter, amounting to 10 to 15 million pounds annually, is marketed for the most part in the urban centres of Eastern Canada.

GENERAL REQUIREMENTS FOR CLEAN MILK PRODUCTION

The Importance of Cleanliness.—Cleanliness is the foundation of good dairying. Quality of the final product, milk, cream, cheese or butter, is largely dependent on care given in the first stages of production.

To produce clean milk, it is necessary to understand and apply certain principles. Milk spoils or deteriorates in quality as the result of bacterial action. Normally, there are very few bacteria in milk when taken from a healthy cow. But it is exposed to contamination immediately it leaves the udder. Deterioration starts at this time and continues until the final product is consumed. Chief sources of bacterial contamination of milk are the utensils, hands of the milker, hairs and dust from the cow, and dust in the air of the barn. Straining removes dirt but does not improve the keeping quality of milk. A sanitary strainer, with a single service lintine type disc, should be used.

Proper Milking Practices.—Studies on milk secretion show the process of "letting down" milk is controlled by the cow's nervous system. Consequently, cows should be properly handled whether hand or machine milking is used. Proper conditioning involves the following points:

1. Avoid excitement of any kind. Cows should be handled quietly and gently.

2. **Immediately before milking,** massage the udder gently with a damp towel soaked in a sanitizing solution at a temperature as warm as the hand can stand (120 to 130 degrees F.). The sanitizing solution is an added precaution against the spread of disease. The warmth and massage stimulate "letting down" of the milk which should result in increased milk production.

3. The first few streams of milk from each teat should be milked into a strip cup and discarded. This is recommended for two reasons:

(a) Mastitis, and other diseases of the udder may be detected.
(b) The number of bacteria in the first few streams is high.

4. Follow the same routine at each milking:

(a) Milk at the same time each day.
(b) Milk "easy milkers" first.
(c) Milk as quickly as possible.

If a milking machine is used:

1. Remove the machine promptly when the milk ceases flowing to prevent injury to teat and udder tissue.

2. Be sure teat cups fit properly. When teat cups start to creep up, pull down on teat assembly and massage each quarter with free hand to ensure complete milking.

3. It is sound practice to dip the teat cup assembly into a sanitizing solution after milking each cow.

4. Follow the manufacturer's instructions on the use and care of the machine.

When cows become used to machine milking and these methods are used regularly, the need for stripping is practically eliminated.

The following additional points should be observed to ensure production of high quality milk:

1. Milk obtained 15 days before and 5 days after calving must not be shipped.
2. Clipping udders from time to time makes cleaning easier.
3. Cows with infected udders or teats should be milked last and the milk withheld from shipment.
4. Handling dry feed, barn cleaning or brushing cows just before milking increases dust in the air and should be avoided.
5. Milk should be removed from the barn promptly.

Prompt and Thorough Cooling.—Bacteria multiply rapidly in milk, particularly if it is warm. This growth can be greatly reduced by cooling milk or cream to below 50 degrees F. Since high quality is dependent on prompt and thorough cooling, milk or cream should be cooled as quickly as possible at all seasons.

Air is a poor cooling medium. For this reason, dairy products should be cooled with running water, ice water or in some type of refrigerated cooler. Care should be taken, however, to prevent freezing. This not only impairs quality, but makes the product very difficult to handle at the plant. Home freezers are not suitable for either cooling or holding milk or cream.

A bulletin: "Care of Milk and Cream on the Farm," may be secured from the Extension Department, University of Saskatchewan, or any Agricultural Representative.

Bulk Tank System of Cooling and Handling Milk.—Adequate cooling of milk on dairy farms has presented a problem for years. A development of tremendous significance in providing rapid and efficient cooling as well as sanitary storage of milk, is the refrigerated bulk milk tank. It avoids the use of cans by storing milk in a cold wall tank where it is cooled rapidly. The milk is pumped from the farm tank into a tank truck for transportation to the dairy plant.

Some of the advantages provided by the bulk milk system are: It reduces and simplifies work on the farm. Quality is more easily maintained. Because the milk is well cooled, less than daily collection can be adopted which in turn results in reduced hauling costs. The loss of milk through spillage and sticking on the walls of cans is reduced (minimum loss of milk per 100 lbs. using cans is about 0.8 lb.).

Since a change to the bulk milk system on a farm requires considerable investment, it is not practical for a small milk producer. The initial investment will involve the cost of the bulk tank and possibly remodelling and rewiring the milk house.

The rapid cooling of milk in farm bulk tanks has made it easier to maintain milk quality. Top quality milk still requires clean equipment and sanitary methods even at cooling temperatures as low as 35° to 40° F. The cleaning and sanitizing procedures recommended by the manufacturer should be followed closely.

Cleaning Dairy Utensils.—Utensils are the main source of bacterial contamination unless carefully cleaned and sanitized. The correct washing of utensils is not difficult, but the procedure should be standardized and followed carefully. There are four distinct steps to be followed in handling metal utensils such as cans, pails and metal parts of cream separators and milking machines. These are rinse, wash, rinse again and sanitize.

1. **Rinse.**—The first rinse is intended only to remove the visible milk from the utensils. This should be done promptly because delay makes the job harder. Rinse with lukewarm or cold water, but never with hot water. Hot water tends to harden the milk solids and makes it difficult to remove them.

2. **Wash.**—After rinsing, wash each piece in hot water containing an improved type of dairy cleanser. Use a brush for washing—not a cloth. The cream separator should be washed each time it is used. Washing only once a day is unsanitary. In addition, the acids formed by bacterial action in the bowl may cause damage to the metal. The rubber ring of the separator should be washed thoroughly and left on a flat surface. Hanging the ring on a nail or peg stretches it out of shape. With the newer types of dairy cleansers, the separator can be washed with much less work than before.

3. **Rinse Again.**—After washing, rinse the utensils in hot water to remove any remaining cleanser. If the water used for rinsing is hot enough, the utensil will dry quickly. No wiping should be needed. Utensils should be kept clean and dry until sanitized immediately before use. Shipping cans should have lids removed and be put upside down on a rack for airing and storage.

4. **Sanitize.**—Immediately before use, all utensils should be sanitized with hot

water and a sanitizing agent, such as chlorine or iodine containing compounds. Remember that sanitizing agents work well only when used at proper strength and on clean utensils. Manufacturers' directions on packages or containers should be carefully followed. Sanitizing agents are available from dairies, creameries and dairy supply houses.

Care of the Milking Machine.—The outline for cleaning dairy utensils applies equally to the milking machine except that the rubber parts require special attention. The following method has proved satisfactory:

Immediately milking is completed and before the vacuum pump is shut off, about three gallons of clean, cold water should be drawn through each unit. The teat cups should be raised out of the water frequently to admit air and so provide better flushing. If done at once, practically all the milk solids will be removed from the tubes. The machine may then be washed and the metal parts sanitized in the regular way.

After washing, the teat cup assembly should be put on a rack, and the rubber tube clamped with its opening up and at the same level as the top of the teat cups. Fill wtih diluted lye solution, made up as outlined, and leave until next milking. Just before milking, drain out the lye solution, and the machine is ready for use. The metal parts of the machine must not come in contact with the lye.

(Prepare stock solution of the lye as follows: Slowly add the contents of a 13-ounce can of lye to a gallon of water in a glass or earthenware jar, stirring gently. Store in corked bottles out of the reach of children. The solution to be used for treating the rubber parts of the teat cup assembly is made by adding one cup of this stock preparation to a gallon of water.)

Inquiries frequently are made as to the type of milking machine to buy. Any of the commonly recognized makes should give satisfactory performance. The most important consideration in selecting a machine is whether or not prompt and satisfactory servicing will be available. If a metering or measuring device is being considered for use with a pipeline milker in a herd which is on Record of Performance, the approval of R.O.P. officials should be secured before the installation is made.

Pipeline Milkers.—With pipeline milkers, the milk is passed directly from the milking unit into either cans or a bulk tank through a sanitary pipeline. This reduces time and labor and is especially well adapted for the bulk milk system. The pipeline must be kept clean or it can be a tremendous source of bacterial contamination in the milk. Such lines are not usually dismantled for washing but are cleaned in place by recirculating cleaning and sanitizing solutions in accordance with the suppliers' direction.

Milkstone Removal.—Milkstone is the white substance which may become deposited in thin films on both the metal and rubber parts of milking equipment. It provides food and protection for bacteria and, therefore, is frequently one of the main causes of high bacteria counts. Milkstone deposits usually harbor large numbers of heat-resistant types of bacteria which survive pasteurization.

These deposits are very difficult to remove by the ordinary alkaline cleansers but can be taken off and prevented by occasional use of an acid type cleanser. The new milkstone removers contain a detergent compound as well as acid and so can be used in place of the dairy cleanser in the wash-up procedure.

The acid compound should be used in the cleaning routine as often as necessary to prevent the formation of milkstone. Since hard waters are the chief source of the deposits, the frequency with which the acid cleanser should be used will depend on the hardness of the water. It is very important to prevent the formation of milkstone. Far less time and labor is needed to prevent its formation than to remove it once it has formed. Under ordinary conditions, use of an acid cleanser once a week should control milkstone formation.

Avoid Feed Flavours.—When cows feed on rapidly growing pasture, summerfallow or stubble, there is a tendency for the milk to take on "feed" or "weed" flavours. Stinkweed gives a very disagreeable flavour to milk, becoming concentrated in the cream and persisting in the butter. The flavour also develops when cows are allowed to eat stinkweed seeds.

Feed flavours and weed flavours can be minimized by taking cows off pastures about three hours before milking. When stall feeding, strong-flavoured feeds, such as silage, turnips and weedy hay, should be avoided for at least two hours before milking. Such feeds may be used immediately after milking. For information on the control of weeds which produce off-favours see section entitled "Weed Control."

EXCLUDE MILK FROM COWS TREATED WITH ANTIBIOTICS

The comparatively recent adoption of preparations containing antibiotics for the treatment of mastitis (see "Mastitis" under Animal Diseases section) has introduced two new problems to the dairy industry.

The first problem is of public health significance and thus is very important. A small percentage of persons are highly sensitive to certain antibiotics, especially penicillin. They may experience ill effects from the quantities in milk from treated udders.

The second problem may cause financial losses in dairy plants. If milk from treated udders is not withheld for six milkings (72 hours) enough of the antibiotics may be carried into the milk to cause failure of starters used in cheese making and in products such as cultured buttermilk.

The Regulations of the Department of Public Health governing milk and milk products provide that a longer period (120 hrs.) must elapse before milk may be sold for human consumption when a quarter of an udder has been treated with a large dose of one or more antibiotics.

SAFE MILK

Milk produced under unsanitary conditions or coming from diseased cows may be a menace to the health of the consumer. If there is doubt as to the safety of the milk for home use, it should be pasteurized or boiled.

Pasteurization consists of heating milk to 145 degrees F. and holding it at this temperature for 30 minutes. If the boiling method is preferred, keep the milk at the boiling point for a full half minute in a covered pot. Milk treated either way should be cooled quickly to below 50 degrees F. Home pasteurizers which automatically regulate the temperature and time of heating are available on the market at a reasonable cost.

CREAM PRODUCTION

As previously mentioned, about half of Saskatchewan's total milk production is marketed as cream through dairy manufacturing plants. Fresh, sweet cream will produce a butter of more delicate flavour and better keeping quality than can be made from sour cream. Therefore, cream should be promptly and rapidly cooled. It should be held at a temperature below 50 degrees, but above freezing. Warm cream should not be mixed with cold cream.

The handling and transporting of cream is most efficient when butterfat is between 30 and 40 per cent. It should be shipped fresh, preferably not over three days old. Protect it from sunlight, cold and dust enroute to the creamery and at the railway station.

VARIATIONS IN BUTTERFAT TESTS

Variations will occur in butterfat tests of successive shipments of milk or cream, produced under apparently uniform conditions. Even where power driven cream separators are used, variations in voltage resulting from heavier loads at certain times of the day, can change the speed of the separator and resulting cream tests. These and other causes of variations must be expected, and should not cause misunderstanding between producer and purchaser. (See Bulletins Nos. 82 and 103 of the University of Saskatchewan, and Circular No. 6 issued by the Canada Department of Agriculture, Ottawa.)

USE OF DAIRY BY-PRODUCTS ON THE FARM

The food value of skim milk is not always appreciated. Whole milk normally contains 12 per cent solid material; about 8.5 per cent is still left in the skim milk. These food solids have great nutritional value, being rich in growth-promoting proteins, vitamins and in bone-building minerals. It is therefore an excellent food for growing children and for the maintenance of health in adults. Skim milk and buttermilk are also of particular value in rations for pigs, calves and poultry.

POULTRY

The information contained in this section is designed to improve the efficiency of farm flocks which provide a portion of the farm living and some additional cash income.

PLANNING THE PRODUCTION PROGRAM

The methods of producing and marketing eggs and poultry are changing. The demand for a quality product by the consumers and the introduction of production and marketing contracts has been a major factor in developing new poultry practices especially those affecting table eggs. There is a definite trend towards the development of localized areas of production similar to the producers of milk in the so-called "milk sheds." In these regions the producers of top quality eggs may integrate their production program with other associated industries such as the feed manufacturer, the hatchery, the registered egg station and/or the retail distributor.

Factors Affecting Returns from Poultry.—For a profitable flock the birds must be (1) good layers (2) carefully reared (3) comfortably housed (4) properly fed and (5) kept free from disease. Careful attention must also be given to handling and marketing.

Choice of Breed.—There is no best breed. For egg production, a lighter weight breed or cross should be selected. The White Leghorn has proved to be very satisfactory. The smaller farm flock owner wants both eggs and good sized market carcass. He will choose such breeds as Barred Rocks, White Rocks, New Hampshires or Light Sussex or crosses of these breeds. The broiler grower will choose one of the several white or nearly white feathered crosses or strains developed for rapid growth, thick fleshing, and efficient feed use.

Keeping Records.—Accurate accounts are essential to the profitable operation of any business. Without records of costs and returns for the poultry enterprise the estimate of profit or loss is merely a guess. The Saskatchewan Co-operative Agricultural Extension Program publishes a poultry account book. Copies may be obtained from the Poultry Division, Saskatchewan Department of Agriculture, Regina.

Size of Flock and Necessary Equipment.—Since the trend is towards larger flocks, an efficient poultry unit for a mixed farm operator must be at least 500 unsexed chicks or 250 pullet chicks.

The commercial egg producer whose main income is from the sale of eggs should have a flock of at least 2,000 layers. Broiler flocks vary in size, but flocks of 20,000-50,000 are not uncommon.

Essential equipment for a flock of 500 unsexed chicks:

1. BROODING PERIOD:
   2 portable brooder houses—each 10′ x 12′.
   2 brooder stoves.
   6 four-foot hoppers or suitable hanging chick feeders.
   2 three-gallon water fountains.
2. REARING PERIOD:
   3 range shelters—each 9′ x 10′ (for the pullets). Use brooder houses for the cockerels.
   5 range feed hoppers.
   5-6 water fountains (depending on size.
3. LAYING PERIOD:
   1 insulated house—30′ x 30′.
   4 five-foot laying mash hoppers or 8 hanging feeders.
   4 ten-foot grain troughs (made of 1″ x 6″).
   168 feet of roosts (2″ x 2″) with droppings pit.
   4 community nests, 2′ x 5′.
   4 containers for oyster shell or limestone and insoluble grit.
   3 five-gallon drinking fountains.
4. FINISHING PERIOD FOR COCKERELS:
   Crate or pen for fattening.

STARTING WITH 500 DAY-OLD CHICKS CAN EXPECT

An average mortality of 10 per cent.
To cull 10% in the fall. These are marketed.
To have 200 to 210 pullets for the laying house.
To market 200 to 220 cockerels.

NOTE: Where only pullets are purchased, only half the equipment shown for the brooding and rearing periods will be needed.

BROODING AND REARING

Many chicks of good quality are ruined by faulty brooding and rearing methods when better care would have produced well developed birds. It is most important, therefore, for poultrymen to use adequate brooder equipment and to employ good brooder management. This means giving the chicks a good start.

Keep the Chicks Warm and Comfortable.—Overheating can be as disastrous as chilling. A brooder thermometer is essential. Hang it two inches above the floor and 18 inches from the brooder. Keep a temperature of 95° to 100° F. for the first week. Lower the temperature 5° per week for the rest of the brooding

period. A chick guard is necessary for the first week or 10 days. Maintain a wall temperature of about 70° to 75° in the brooder house. If the chicks are huddled close to the brooder stove, the temperature is too low. If they are around the walls of the house, the temperature is too high. Some heat is required until the chicks are well feathered.

Suitable House and Equipment.—If only 30 to 50 chicks are to be raised, it is easy and economical to use electricity for brooding. One or two infra red heat lamps (250 watts) properly wired into the lighting system will give enough heat. Large infra red heat lamp units may be used where electricity is available, provided that ample additional heat is available to maintain room temperature. A single section of battery-type brooder is useful for the small flock owner. For larger flocks, an efficient unit consists of a portable colony brooder house (10′ x 12′). This is equipped with a coal, oil or gas brooder stove and a number of chick feeders and waterers. Where gas is used, special care should be taken to provide ample ventilation. The brooder house will accommodate 250 chicks to six weeks of age. Not more than 300 chicks should be brooded under one brooder, regardless of its rated capacity. The capacity of a brooder house is two chicks per square foot of floor space.

Before the chicks arrive, give the brooder house a thorough cleaning. If possible this should be done in the fall before cold weather. Use a scraper on the floor. Follow this by a good scrubbing using a disinfectant such as 1 pound of lye to 5 gallons of boiling water. Coal tar disinfectant should only be used when the brooder house can be thoroughly aired. Walls and ceilings should be washed and whitewashed. Start the brooder stove a week before receiving the chicks so that the house will be completely dry and the stove adjusted and operating properly. Chaffy or cut straw or planer shavings can be used as a litter on the floor and should be changed when damp. Peat moss, peanut shells and vermiculite are good commercial litter materials.

What to Feed.—A good commercial chick starter in mash or crumble form should be fed for the first six to eight weeks. To control coccidiosis during brooding feed a medicated starter. One hundred chicks will eat about 200-300 pounds of starter during this period.

At first the feed can be sprinkled on clean egg flats or pieces of cardboard, but after the second day use proper feeders. Allow four feet of trough space for each 100 chicks. This should be doubled after two weeks. Fill the troughs daily with fresh feed. Give water to drink. For the first week or so remove the chill from the water. Provide at least one three-gallon drinking fountain for each 100 chicks at the start and two after 10 days. Clean these daily. It should not be necessary to add disinfectant or other material to the drinking water. At six to eight weeks gradually change the chicks from starter to growing feed. Also, introduce a small amount of grain. At this age, they can be allowed to run outside on clean grass pasture.

Management.—Watch for toe picking. (See section on Feather Picking and Cannibalism.) Teach the chicks to roost early. Two inch by two inch roosts can be used at or near the back of the brooder. Place these 12 inches from the floor. Tattoo chickens with registered letters if there is a danger they will be stolen.

Supply Clean Range.—From the time the birds are well feathered until maturity, they should be reared on good green range entirely separate from adult stock. Clean range is pasture that did not have chicks on it the previous year. Use range shelters for the pullets and the portable brooder house for the cockerels. Allow at least one acre of pasture for each 200 birds. Shade for the growing birds will help keep them gaining in weight during hot weather. Barrel waterers equipped with automatic float valves and large range feeders can save much time.

CULLING

Culling means removing poor birds. Every poultry man must learn and practice it to get best results. Culling should be a continuous process. Weak or crippled chicks should be removed as soon as noticed. When the pullets are housed in the fall, only well-grown birds free from defects should be kept. As the laying season advances, birds not laying their full share of eggs are marketed. The main differences between a poor layer and a good layer are shown in the following chart.

Part of Body	Good Layer	Poor Layer
Comb and wattles	Large, red waxy	Shrivelled, dry, pale
Head	Refined, short, bright	Coarse, long, fat
Eyes	Prominent, bright	Small, sunken
Vent	Large, moist, oval	Small, round, dry
Pubic bones	Thin, wide apart	Thick, hard, close, together
Color	Pigment bleached	Yellow pigment in vent, beak, shanks
Skin	Thin, soft	Thick, coarse
Shanks	Flat	Round, coarse
Back	Broad	Narrow
Body	Moderately deep	Shallow
Keel	Straight, long	Crooked or short
Molt	Late	Early

The flock owner should replace his whole flock with pullets each year. Three advantages are: (1) It gives the owner about two weeks to clean and prepare the laying house for the pullets. (2) More eggs are produced, especially in the fall months. (3) There is definitely less disease loss.

HOUSING THE LAYING FLOCK

SIZE AND TYPE

A. Deep houses (at least 28 to 30 feet) are cheaper to build and easier to ventilate and should be warmer.

B. Allow 3½ square feet of floor space for heavy breeds and 3 square feet of floor space per head for light breeds unless you use a good fan ventilation system.

C. Insulation of both walls and ceiling is very essential. Commercial bat or fill type insulations are recommended but dry planer shavings or dry chaffy straw can be used.

D. Vapor proof paper should be used between the inside sheeting and the studs. Unless this is done, the insulation will become wet with the condensing moisture and rapidly lose its value.

E. Cement floors are the best for the permanent laying house. Insulate it with six to eight inches of gravel or cinders before pouring the cement. Dirt floors are not recommended as they soon become a disease hazard.

F. One 40 watt bulb with a reflector for each 200 square feet of floor space. Two rows of lights for houses over 24 feet wide. A 14-hour day is recommended.

G. Slatted floors, wire floors, laying cages are other systems of laying flock management.

VENTILATION

A hen uses three times as much air per pound of body weight as does a cow. She also produces much more water vapor per pound of body weight.

A. Gravity Systems

The shaft or flue system is popular. Flue size depends on the number of birds. Two and one-half square inches of cross-sectional area for each bird. The flue should extend to the floor and have an adjustable slide near the floor to control air movement. It is important to insulate the flue from ceiling level to the top. Fresh air is brought in through tilting windows or inlet vents. Another method is an eight inch slot across the front wall, above the windows and controlled by a baffle board or sliding drawer.

B. Forced Air

Electric fans of the right size and design are being use quite extensively by larger poultry flock owners. It is doubtful whether the expense can be justified with less than 500 hens or without reducing the floor space allowed each bird to 2-2½ square feet each. Advice from University or Department of Agriculture personnel should be sought before installing fans.

LAYING HOUSE EQUIPMENT

A. Dropping Pits

Roosts are placed 18 to 20 inches above the floor. Heavy wire (14 gauge 2" x 2" welded wire is suitable) is placed under the roosts and light wire used around the outside of the pit.

B. Nests

Plenty of nests, with clean nesting material, help greatly in producing clean eggs.

1. Community. Simply a large darkened box without partitions and with six to eight inches of dry shavings or other nesting material.
2. Roll-away. These nests have a sloping wire floor designed to reduce egg breakage and work quite effectively for some poultrymen.

3. Single. Are widely used by poultrymen. Care should be taken in their construction so that they are not too large as hens will tend to crowd into them and excessive egg breakage will result.

C. Built-up Litter

Start it in September or earlier and use dry material only. Use 6-8 inches of chaffy or cut straw for a start and add more as it becomes broken down until there is 10 to 12 inches of dry loose litter. Stir the litter to prevent caking. One pound of hydrated lime for each 10 birds can be stirred in every 3 to 4 weeks and this will help keep the litter dryer.

D. Feeders

Place some of the feeders over the roosts. This will help the shy birds to get sufficient feed.

1. Troughs. These can be purchased or home-made. About 40 feet of feeding space should be provided for each 100 hens. Never fill the feeders more than ½ full.
2. Hanging Feeders. Provide 3 of these for each 100 hens.
3. Mechanical Feeders. These are available but are not considered economical for fewer than 1000 hens.

E. Waterers

Automatic waterers are recommended where feasible. Where possible, place them over the dropping pit or some other wire covered platform in order to keep the litter from getting wet. If pails are used immersion heaters will help prevent freezing.

FEEDING

Poultry raisers may find it worthwhile to market part of the grain crop as eggs and meat. Poultry production is profitable at present grain prices. However, to obtain largest returns from the grain fed, it must be properly supplemented with protein, minerals and vitamins. A rate of 60-65 per cent egg production must be kept up throughout most the year.

SYSTEMS OF FEEDING

A. Home Grown Grains plus Concentrates or Supplements

1. Be sure to mix according to the directions of the feed manufacturer.

2. If concentrate is fed in the powdered form, mix with the proper proportion of chop. Feed in open hoppers without restriction. Feed whole grains once or twice a day. Equal amounts of mash and whole grain should be fed.

3. If fed in the pellet form, mix in the proper proportion with whole grains. Feed in open hoppers without restriction. This mixture is the complete diet.

B. Commercial Mashes

1. These are complete feeds used by commercial egg producers and broiler raisers who buy all their feed.

C. Mixing Own Concentrates

1. These are not recommended for the average producer because of difficulties in weighing small quantities of some ingredients and thoroughly mixing all feedstuffs.

FEEDING INSTRUCTIONS

1. For chicks, see section on Brooding and Rearing.
2. For broilers, see section on Broilers.
3. When the birds are on pasture, use (a) a growing mash consisting of ground grains plus concentrate with scratch grain or (b) whole grain plus concentrate pellets.

4. Total feed consumption will average 20-25 pounds per bird while on range.

5. Move pullets to laying house when about 10 per cent are in production or not later than September 30.

6. Total feed consumption for 100 layers will vary between 22-30 pounds per day. This depends upon the breed and rate of production.

7. Water is essential at all times. Daily consumption for 100 hens is four to five gallons.

8. Calcium grits are fed free choice to the layers. Each bird will eat four to five pounds per year.

9. Granite grits may be fed free choice to layers.

10. Skim milk or buttermilk can be used in place of water.

SLUMPS IN PRODUCTION

1. Usually caused by faulty management.

2. Make sure pullets are in good flesh when moved to their laying quarters.

3. Avoid sudden changes in feed. Change from one feed to another over a period of 10-14 days.

4. Prevent sudden changes in temperature and avoid exposure to drafts.

5. A slump in production will be preceded by a lowered feed and water consumption.

6. A severe slump is evidenced by a neck molt. Return to normal production requires six to eight weeks.

7. If a slump is seen, use a supplementary feed. Use either of the two following methods.

(a) At noon feed three to four pounds of the laying mash mixed with 1½ to two pounds of warm water or milk for each 100 birds. Continue until spring and gradually taper off.

(b) Feed same amount of supplementary pellets at noon for the same period of time. Taper off gradually.

8. Don't use a supplementary feed unless necessary.

FINISHING COCKERELS FOR THE ROASTER MARKET

1. Don't market too early. Finish at about six to 6½ months of age.

2. Run your fingers through the feathers on the back of the cockerel. If there is any quantity of pin feathers, delay fattening for several weeks.

3. Pen fattening requires about three to four weeks; crate fattening about two weeks.

4. Feed a mixture of ground wheat, barley and oats (with the hulls sifted out). Ground wheat is the best single grain to feed.

5. Mix with milk, two parts by weight for each part of ground grains.

6. If milk is not available, add 10 per cent meat scraps.

7. Feed the cockerels twice a day all they will clean up in 20-30 minutes.

8. Ten birds will eat about 4½ pounds per feeding.

9. Capons may be grown and finished to provide heavy roasters for home use and for specialized hotel or restaurant trade. The surgical method of caponizing is recommended. Hormone implants may be used to produce a temporary caponizing effect but it is important that treatment be given at least 6 to 8 weeks before marketing.

Broilers

1. A specialized industry, limited in Saskatchewan.

2. A broiler strain of chickens must be used.

3. A broiler feed must be used.

4. Birds must be confined for the entire 10-12 weeks.

5. A minimum of one square foot of floor space per chick is required.

6. Management is otherwise the same as for replacement stock.

7. Profits depend upon volume production.

Feather Picking and Cannibalism

1. Usually caused by overcrowding, overheating or feeding an improperly balanced diet.

2. Treatments such as covering the picked areas with axle grease or commercial preparations may help.

3. Debeaking is a sure cure. Birds of any age can be debeaked. Avoid debeaking in cold weather.

4. Mechanical devices such as "henspecs" will prove helpful in controlling picking.

Soft Shelled Eggs

1. Check feeding program.

2. Usually caused by overfeeding whole grains or diluting the concentrate with too much chop.

3. Discourage egg eating by darkening nests and collecting eggs more often.

CARE AND MARKETING OF EGGS

How to Produce Quality Eggs.—Egg marketings in Saskatchewan show the peak production period is from January to July. During this period the spread between grade A and grade B eggs will vary from 10 to 20 cents per dozen.

The quality of an egg cannot be improved after it is laid. But it will lose its original quality rapidly if not properly cared for. The following practices will assist in producing and maintaining good quality.

(a) Buy chicks from flocks known to produce eggs of good size, shape and color, with strong shells and firm whites.

(b) Produce strong shells and moderately colored yolks by following the feeding practices outlined herein.

(c) Confine the hens to the laying pen from the time they are housed in the fall until they are marketed. Do not let them out at any time.

(d) Remove male birds immediately after the breeding season.

(e) Remove and "break up" broody hens immediately.

(f) Keep the nests clean to prevent soiled shells. Use four to six inches of shavings or chaffy straw. Do not wash eggs unless absolutely necessary. Then use clean warm water with detergent. Washed eggs should be used for immediate consumption only.

(g) Gather eggs in wire baskets several times daily. Cool immediately.

(h) Hold eggs in a cool, moist place overnight before crating. A holding temperature of 45 to 55 degrees F., with a humidity of 70-80 per cent, is recommended.

(i) Pack eggs large end up in clean cases and fillers.

(j) Ship twice weekly to the nearest registered egg grading station.

(k) Specialized egg producers should obtain information on Egg Quality Programs from the Poultry Division, Saskatchewan Department of Agriculture, Regina.

MARKET POULTRY

1. All poultry marketed through registered poultry stations is graded in accordance with the Dressed and Eviscerated Poultry Regulations under the Canada Agricultural Products Standards Act.

2. All poultry so marked is subject to inspection for compliance with grading and marking regulations by the Inspection Staff of the Poultry Division, Canada Department of Agriculture.

3. All poultry processed and eviscerated in plants under Health of Animals supervision is inspected for wholesomeness.

4. In the main centres of consumption all poultry must be grade tagged and sold by the retailer on a graded basis and all poultry in retail outlets in these centres is subject to inspection by officers of the Canada Department of Agriculture.

5. Only a registered poultry station or a registered producer may apply grade tags to poultry.

6. Consumer demand for eviscerated poultry has almost completely replaced the demand for dressed poultry and, consequently, eliminated farm dressed poultry in the marketing program.

7. For best returns poultry should be well fleshed and well finished before marketing; fat is an important factor in grading.

8. The bulk of poultry is marketed today on a rail graded basis. Arrangements for the delivery of birds to the processing plant should be made well in advance of the selling day in order to prevent delay in processing the birds.

9. Extreme care should be exercised in catching, crating, transporting, and unloading of live birds in order to avoid bruising, broken bones and unnecessary mortality in the process.

10. It is unlawful to transport poultry during freezing weather without adequate protection.

PREVENTION OF DISEASE IN POULTRY

The four basic principles of disease prevention are: (1) Purchase all chickens and turkeys as day old, disease free, chicks or poults that are the progeny of good breeding stock (2) Feed an adequate ration (3) Supply the birds with surroundings that are comfortable and clean (4) Control infectious disease.

Sanitation is the provision and maintenance of healthy surroundings. Land chosen for poultry range and the poultry house should be well drained. It should not be in the path of drainage from the farmyard generally or from the range and housing of other birds and animals. Houses should be constructed to enable maximum use of sunlight as a disinfectant, have an adequate ventilation system and to exclude wild birds. Isolate from other lots of poultry, pigs and other animals. Feeders and waterers should be located to prevent contamination with litter and droppings. Waterers should not create wet spots or puddles. Rats and mice should be kept controlled by trapping and poisoning with warfarin.

The most important source of disease is carrier birds. Management to keep different lots of birds isolated is the important aspect of this problem.

MANAGEMENT PRACTICES FOR DISEASE PREVENTION

1. Locate brooder house on ground on which birds have not formerly run. Fence an area around it for range. Before bringing home baby chicks or poults, clean and prepare the brooder house. Wash thoroughly using boiling hot 2% lye solution (water—five gallons, lye—one pound), rinse, allow to dry, spray to point of run-off with water suspension containing 5% DDT and 0.25% Lindane.

2. Buy quality, day-old, disease free chicks or poults. During brooding, keep confined to brooder house and fenced area. Keep old birds and other animals away from the young birds.

3. Clean range housing thoroughly before chicks are moved to range. Finish up with a spray of DDT and Lindane as above. Sprinkle malathion powder on floor.

4. Warning! Get completely rid of all old birds one month before pullets are moved into the laying house. During this time, clean laying house and treat with insecticide. In addition, disinfect and apply insecticide in the laying house in late June to keep lice, mites and fleas down.

5. Keep pullets and hens separated from other animals—especially pigs—at all times.

TURKEYS

Turkey production in Saskatchewan has undergone some very definite changes during the past few years. Numbers have almost doubled since 1953. Turkey raising has become a highly competitive industry. Satisfactory returns, over investment, will be possible only where efficient management practices are followed. Flock size must not be increased out of proportion to the facilities for handling them. Mortality must be kept below ten per cent and management practices must be such as to produce a satisfactory tonnage of well finished turkeys within a reasonable length of feeding period.

The following outlines should serve as a guide to the important points in turkey production:

I. Special Requirements for Brooding Poults. (See also section on Brooding Chicks.)

(a) A regular sanitation program for all equipment and brooder houses.

(b) One square foot of floor space per poult.

(c) Litter should be covered with opened out sacking for the first week. Scatter a few handfuls of chick sized grit over the sacking. Stir litter frequently.

(d) Provide numerous small glass waterers and feeders made from egg trays. A little rolled oats scattered over the starter at intervals will attract them to it.

(e) Never more than 250 to 300 poults per brooder. Beginners should reduce this to 150 to 200 poults.

(f) Seven to eight pounds of starter will be required for each poult to eight weeks of age.

(g) Three 4-foot starting feeders per 100 poults should gradually replace the egg trays after the first few days.

Larger feeders should again be substituted as the birds increase in age.

(h) Two 1-gallon waterers per 100 poults are necessary till automatic waterers can be used. One 4-foot automatic waterer will handle up to 150 poults.

II. Requirements for Growing Turkeys from Eight Weeks to Market Time.

(a) Ample clean range or confinement space. One acre of land not ranged by turkeys for at least one year for each 100 turkeys or five square feet per bird in a pole barn.

(b) Sixteen pounds of a 33-35 per cent protein, mineral-vitamin concentrate per bird during this period—usually fed in pelleted form. Eight pounds of this should be fed during the period of rapid growth from 8 to 16 weeks of age.

(c) Seventy-five pounds of grain per bird. From 8 to 12 weeks of age this can be cracked but thereafter can be fed whole. A good mixture consists of two parts wheat to one part plump oats. Concentrate and grain are usually mixed in the proportions shown in Table I.

Table 1

CONCENTRATE PELLETS AND GRAIN REQUIRED PER 100 TURKEYS AT VARIOUS AGES

Age in weeks	Pounds of concentrate pellets per week	Pounds of whole grain per week	Ratio
8-12	120	160	1:1.33
12-16	100	280	1:2.80
16-20	80	360	1:4.50
20-24	60	475	1:7.92
24-28	40	530	1:13.25

(d) The equal of 20 feet of feeder space and 10 feet of waterer space per 100 turkeys. Feeders are best designed so that they can be moved. They should also be lined up on range so that they can be filled mechanically. Plastic water lines and automatic waterers will save much time and labor.

(e) Shelters will be required during the early summer months and again during the fall and early winter. Heavy losses and poorly finished birds have resulted where ample shelter was not provided.

(f) Regular moving of feeders and shelters will prevent build up of contamination and make better use of greenfeed.

(g) Debeak all confinement reared turkeys at 8 to 10 weeks of age.

(h) Wing notch birds on range.

(i) Fattening will occur when the birds are mature (24-26 weeks for females and 26-28 weeks for males). Maturity can be hastened by proper attention to diet. Management practices designed to prevent set backs and stress periods also have an influence on maturity. However, holding

turkeys beyond the stage at which they are first ready for market can be uneconomical due to the widening of the feed-grain ratio. The resulting gains can be costly in terms of feed required (see Table 2).

Table 2
POUNDS OF FEED TO PRODUCE A POUND OF GAIN

Age in Weeks	Feed Required Per Pound of Gain: Hens lbs.	Toms lbs.
24	9	5
26	13	5½
28	17	9½

(j) Concentrated turkey production on the prairies makes a sanitation and disease control program even more important. Well-fed, well managed flocks are less disease susceptible than those on a deficient diet or those subjected to repeated stresses.

III. Requirements for Breeding Flocks.

(a) Carefully selected hens and toms. Culling should be a continuous process.

(b) Well-built, well-ventilated laying houses. Provide five square feet per bird if an outdoor run is available; ten square feet if totally confined.

(c) Ten toms are required for each 100 hens. Spares should be available.

(d) One 2′ x 6′ community type nest for each 25 hens. Single compartment semi-trap nests are preferred by some operators.

(e) Canvas saddles for all hens. The toms toe nails should be trimmed.

(f) Artificial lights to bring hens into early season production. A fourteen-hour day is required. Toms should be lighted three weeks ahead of the hens.

(g) A well-balanced breeder ration for all birds at least a month before eggs are expected.

(h) Broody coops or pens. Broody hens should be broken up at first signs of broodiness to keep up egg production.

(i) Collect eggs frequently and cool to 50° to 55°.

Breeds and Strains of Turkeys

The Broad Breasted Bronze turkey has been the most popular breed in past years. Cross breeding and strain crosses are being used in an attempt to produce turkeys which grow faster and mature earlier on less feed. Some progress has been made.

Percentage of Grade A Eggs Inspected in Saskatchewan 1950-1958

Year	Percent
1950	48.9
1951	57.5
1952	51.1
1953	49.3
1954	56.6
1955	53.9
1956	51.3
1957	49.0
1958	52.3

Egg Production per Hen in Saskatchewan 1950-1958

Year	Production Eggs
1950	121
1951	121
1952	154
1953	155
1954	143
1955	149
1956	157
1957	167
1958	171

POULTRY DISEASES

Disease	Occurrence	How to recognize	Prevention	Treatment
Tuberculosis (Infectious)	Adult chickens Pigs Adult turkeys	Deaths one by one, weight loss, listlessness, pale comb, whitish spots in liver and spleen. Nodules on intestine. Sometimes sudden deaths from internal bleeding.	Adopt procedure outlined under "Prevention of Disease in Poultry" (Page 150).	None. For more details write Veterinary Science Dept., University of Saskatchewan.
Infectious Respiratory Diseases General (also see next three diseases below.)	Chickens only—Bronchitis and laryngotracheitis. Chickens and turkeys—Coryza and Newcastle disease.	Rattling wheesy breathing, gasping, nasal discharge, egg production stops. Only poultry diseases specialists can tell these diseases apart.	Severe respiratory disease with high mortality should be brought to veterinary attention without fail.	See CRD, air-sac disease, and vitamin A deficiency below.
CRD (chronic respiratory disease) (Infectious)	Common in chickens and turkeys at all ages. Chronic carried. Transmissible through egg.	Chicks—wheezy, noisy breathing. No nasal discharge (dry head). Poor doing. Mortality about 10%. Hens—poor production fertility and hatchability. Relapses. Turkeys—"Swell-head", *i.e.*: puffy swelling in front of eyes. Laboratory blood tests will give a definite diagnosis.	Buy day-old chicks from sources setting no hatching eggs except from CRD-free breeding flocks. If CRD exists on a farm get rid of all birds and start over with day-old CRD-free chicks. Drugs will not prevent CRD.	Medicate feed with streptomycin or tetracycline, 100 grams per ton and feed continuously; or medicate drinking with one of the above drugs according to label instruction.
Air-Sac Disease (Infectious)	Common in chickens and turkeys. Often complicate CRD. Caused by moulds and bacteria in egg as result of faulty sanitation in hatching egg production.	Ten percent mortality in first week. Large navel scabs. Unabsorbed yolk. Flecks and masses of yellowish cheesy pus in air sacs and body cavity with thickening of membranes.	Laying house cleanliness to prevent dirty eggs. Do not wash hatching eggs. In fumigating hatcheries use 1.5 cc. formalin per cubic foot for 24 to 48 hours.	None completely effective. Treatment as for CRD above, improves growth and production. No treatment will remove pus from the air sacs.
Vitamin A Deficiency (Nutritional)	Common in all poultry.	Poor growth and production. Deaths. Swollen, roupy heads and eyes. Wasting. Paralysis. Lameness. Small pustules in mouth, gullet, crop and true stomach (not gizzard).	Correct feeding program (see page 148).	In affected flocks, in addition to correcting the feeding programme, place containers of fish liver oil in the pens allowing the birds to help themselves for a week.
Cecal Coccidiosis (Infectious)	Chickens 2-14 weeks old.	Droopy, off feed, bloody droppings, high mortality. Blood or cheesy cores in Caeca (blind guts).	Separate young birds strictly from old birds and their droppings. Avoid tracking in of infection. Avoid dampness and overcrowding. Utilize sunshine and drying to kill infection on ground and in houses and shelters. Use feed medicated at preventive level. Effective drugs are too numerous to list here.	Sulfamethazine or sulfaquinoxiline in drinking water according to directions on label of container.
Intestinal Coccidiosis (Infectious)	Chickens 2 weeks and older.	Droopy, off feed, sometimes blood in droppings. Mortality may be fairly high in acute outbreaks low when chronic.		

Disease	Occurrence	How to recognize	Prevention	Treatment
Hind-gut Coccidiosis (Infectious)	Turkeys 2-16 weeks.	Droopy, off feed, light to moderate mortality. Caeca (blind guts) and intestine from caeca to vent full of yellowish cheesy matter.	See Prevention of chicken coccidiosis, immediately above. Where turkey coccidiosis is known to occur use prestarter and starter containing 0.0175-0.62% sulfaquinoxiline. When the disease is suspected have diagnosis confirmed by a veterinarian or a laboratory because coccidiosis resembles other severe diseases in turkeys.	Use feed containing 0.05% sulfaquinoxiline. Feed it on two days, off three and so on until outbreak is over; or give sulfaquinoxiline in drinking water according to directions on label of container.
Duodenal Coccidiosis (Infectious)	Turkeys up to three months	Birds very sick, very high mortality. First part of intestine (duodenum) congested, with bloody contents.		
Blackhead (Infectious)	Highly fatal in turkeys more than a month old. Carried by chickens in the cecal worm (see "Worms" below).	Turkeys droopy and very sick. Watery droppings in which the normally white matter is bright yellow. High mortality after 2-6 days sickness. Liver shows ulcer-like to tumor-like spots. Ceca (blind-guts) with thickened inflamed walls and layered cheesy bad smelling cores.	Do not keep chickens and turkeys on same farm. Move poults to ample open, clean, dry range at 9 weeks. Avoid overcrowding, shaded range and damp spots. Feed continuously in mash: Amino-5-Nitrothiazole 0.025-0.05%; or 2 Acctyloamino-5-Nitrothiazole 0.015%; Nithiazide 0.025-0.05%.	Feed mash containing 2-Amino-5-Nitrothiazole 0.1% for 14 days. Repeat in 14 days if necessary; or 2-Acetylamino-5-Nitrothiazole 0.05% for 14 days only; or Nithiazide 0.5% for 7-14 days. Give any of above in drinking water according to directions on label of container.
Bluecomb Complex (Infectious, at least in part).	Very common in chickens and turkeys of all ages. Bluecomb complex may be two or more diseases that cannot at present be told apart.	Typical Bluecomb-Acute fatal cholera-like disease mortality usually less than 10%. Non specific enteritis: Severe inflamation throughout intestine with diarrhea and poor development. Nephrosis: very droopy as in coccidiosis. Kidneys greatly swollen and pale. Visceral Gout: droopy and wasted. Kidneys swollen and whitish. White chalky film over liver, chalky material in heart sac.	Effective prevention is not known. Acquire poults or chicks from breeding flocks free of the disease. Avoid overcrowding. Practice cleanliness. Keep birds from different sources separate. Avoid feeding new grain or else feed it sparingly. Avoid sudden changes in feeding and management. Feed mash containing tetracycline 50 grams per ton to the exposed birds.	Feed mash containing tetracycline 500 grams per ton; or give tetracycline in drinking water according to directions on label of container.
Fowl Cholera (Infectious)	Chickens and turkeys, four to six months of age. Recovered birds are carriers.	Sudden onset. High mortality after short illness. Sometimes nervous spasms at onset of outbreak. Birds may drop dead suddenly. Marked internal changes but these not distinquishable from erysipelas, bluecomb and other diseases. In cholera the lungs are nearly always affected. Take birds to a laboratory or veterinarian.	Avoid overcrowding. After an outbreak get rid of all surviving birds a month before bringing in new day old stock. Do not permit visitors. Be careful not to track in infection. Do not vaccinate as this increases the carrier problem and enables infection to carry over from one year to the next.	Inject a combination of penicillin and streptomycin into breast muscle of each bird according to label instructions. Give sulfamethazine or sulfaquinoxiline in drinking water according to label directions. Treatment is not fully satisfactory.
Erysipelas (Infectious)	Turkeys, mostly males, past four months of age. Pigs. The disease is transmissible to man. Apparently healthy pigs and turkeys may be carriers.	Not distinquishable from cholera except on laboratory examination. Consult a veterinarian or take sick birds to laboratory. Lungs not usually affected.	Avoid overcrowding. Vaccinate at two months of age using a lysate vaccine and again at 15 to 16 weeks. Keep turkeys where no spread of infection from pigs or sheep can occur. Control rats and mice.	Inject a combination of penicillin and streptomycin into breast muscle according to label instructions. The tetracycline are also effective in feed or drinking water.

Disease	Occurrence	How to recognize	Prevention	Treatment
Arthritis (Infectious)	Turkeys, and to a lesser extent chickens. More prevalent in hot weather.	Severe sickness, greenish diarrhea, extreme lameness, swollen, hot painful joints containing greyish fluid with tiny fleck to large masses cheesy pus. Liver greenish, spleen enlarged, intestine inflamed.	No effective preventative measures are known. Avoid overcrowding and maintain cleanliness. Feed an adequate ration. Obtain day old poults from breeding flocks where arthritis does not occur.	Remove, kill and burn affected birds, move healthy birds to clean ground. Tetracycline given in drinking water may be tried, but no treatment has been found very effective.
Range Paralysis (Infectious)	Chickens, past 9 weeks of age. The disease is carried and transmitted through hatching eggs.	Lameness in one leg. drooping of one wing, paralysis with inability to stand, sometime blindness, eventually death. Internal abnormalities usually absent. Nerve to affected leg or wing may be enlarged.	Buy chicks that are the progeny of established local breeding flocks as such birds are resistant to local infection. Avoid buying imported chicks. Avoid overcrowding. Keep surroundings sanitary. Provide adequate housing feed and water.	There is no effective medicinal treatment. Gather up sick birds, kill and burn them.
Leucosis Complex (Infectious)	Chickens, four to 11 months old. Very common some years. The disease is carried and transmitted through the hatching egg.	Wasting illness lasting one to several weeks. Anemia. Greatly enlarged liver of variable appearance. Spleen may be enlarged. Other organs may be affected.	Same as for range paralysis.	No medicinal treatment is effective. Gather up and burn all dead and sickly birds.
Worms (Infectious)	Chickens and turkeys. The cecal worm carries blackhead, and is the only worm widely prevalent under conditions of good management.	Unthriftiness, sometimes death. Finding worms on opening intestine. The large round worm on occasions is found in eggs. The occurence of blackhead is definite proof of cecal worm presence.	Rear young birds on clean ground out of contact with old birds or their droppings. Locate housing and pick range land with a view to dryness and exposure to direct sunlight. Control flies and grasshoppers. Use waterers that do not cause damp spots (see Blackhead above.)	Medicinal treatment is not recommended. Adequate management will control all poultry worms in Saskatchewan except cecal worms. The latter are so widespread and so hardy that attempts to treat are futile.
External parasites (Lice, fleas and mites)	Chicken and turkeys.	Restlessness, unthriftiness, lowered egg production, meat birds will not fatten. After plucking, skin may appear scabby and scaly in places. Anemia. Presence of lice, mites and fleas on birds. Observing mites in building.	Adopt management practices for "Prevention of Disease in Poultry" outlined on page 150. Keep out wild birds as they spread mites and fleas. Dust malathion on floor beneath litter. If "Deep litter" is used dust malathion beneath each fresh layer of litter added.	If management is adequate, treating the birds is seldom necessary. When it is, each bird may be dusted with louse powder containing sodium fluoride. Nicotine sulfate, painted on roosts is an aid in controlling mites.

ANIMAL DISEASES

Obtaining maximum profits from the production of livestock and poultry requires that good herd and flock health be maintained, and that diseases, particularly infectious diseases, be controlled. More and better means for the control of diseases exist today than ever before. However, no single means is a cure-all. Animal health can be most easily achieved on a high plane through the application of veterinary and husbandry sciences within the framework of sound animal health and disease control programmes.

Animal and poultry diseases pose perhaps the biggest scientific and technological problem facing the two industries in the province. Until the veterinary shortage is corrected, much disease control must remain make-do and make-shift.

Sick animals and disease outbreaks should be examined early by a veterinarian so that proper diagnosis and treatment can be given. Delay involves the risk that serious disease might go improperly diagnosed until it has spread and become difficult to control. Descriptions in letters without visiting and seeing cases are often misleading and result in wrong diagnosis and instructions.

GENERAL CONSIDERATIONS

Infection Reservoirs.—Many disease-producing germs are harboured in soil, water, manure and buildings, e.g. blackleg, tetanus and anthrax organisms. These form resistant spores capable of long survival. Most worm infections are harboured for long periods in similar places.

Infection Carriers. — The germs of many important diseases are incapable of surviving more than a short time (a few days or a very few weeks) in soil, water or buildings. The germs of such diseases are often carried by certain individual animals, either permanently or for extensive periods of time. Carriers are able to transmit infection to susceptible animals.

Vaccination of an animal does not always prevent it from remaining a carrier. Drug treatment cannot be relied upon to clean up animal carriers.

Build-up. — Carriers among closely confined animals initiate spread of infection to uninfected stock. Passage of a disease germ from animal to animal rapidly increases the amount of infection in the surroundings and causes the virulence or disease-producing power of the germ to increase. The body defences then may be overpowered by exposure to the great amount of more virulent infection present and a general disease outbreak follows. This process may be referred to as infection build-up.

Predisposing Causes. — Conditions such as severe weather, shipping, decreased feed intake, lack of water, the close confinement and excitment connected with weaning, permitting access to undesirable surroundings, pregnancy, heavy milk production, etc., are considered to play a part in disease causation. These are called predisposing causes.

Predisposing causes are often called "stresses", but the latter term is not entirely accurate.

DISEASES OF CATTLE

Shipping Fever.—The cause is superposition of bacterial infection on virus pneumonia, most commonly virus calf pneumonia. A variety of bacteria may be involved but in most cases the bacteria are (1) Type A and B strains of **Pasteurella multocida**, and/or (2) **Pasteurella hemolytica.** Apparently healthy animals may be carriers of both the viral and bacterial agents. Rapid build-up and spread occurs under conditions such as close corralling range calves for weaning, packing cattle into trucks, cattle cars, stockyards, and the placement in feedlots of cattle acquired from various sources.

The symptoms in mild cases are fever, loss of appetite, coughing, nasal discharge, eye discharge, sometimes diarrhoea. In severe cases pneumonia develops. In the latter the symptoms are much the same as in the mild disease with the exception that breathing is laboured, loss of appetite is usually complete, and death is likely to occur.

Steps to prevent shipping fever include:

1. A month before shipping or transporting, inject each animal subcutaneously (under the skin) with mixed bacterin (vaccine) made from Canadian strains of **Pasteurella multocida** and **Pasteurella hemolytica.**

2. In the same way, vaccinate all cattle at home a month before bringing new cattle into the herd.

3. For three to five days before shipment and for at least three days after arrival at farm or feedlot, give tetracycline drug in the feed. The drug must be added to the feed in an amount to

insure that animals up to 400 lbs. will receive 500 milligrams per day, animals 400 - 750 lbs. receive 800 - 900 milligrams and animals over 750 lbs. receive 1000 milligrams. If 500 grams of tetracycline drug is added to a ton of feed, one pound of feed will contain 250 milligrams of drug.

4. All cattle, except those for slaughter that have been shipped should be isolated for fourteen days. If they remain healthy, they can then be added to the herd.

Sulfamethazine may be given by mouth to treat shipping fever. The dose is 1½ grains per pound body weight followed by ½ grain per pound body weight for three days. It is best to call a veterinarian because home treatment often fails owing to complications.

Blackleg. — The cause is a spore-forming bacterium called **Clostridium fesseri,** or until recently **Clostridium chauvei.** The spores may survive in soil for years. Initially, cattle pick up spores from the soil, or from feed that has become contaminated. The development of the disease may be triggered by the enterotoxemia organism growing in the intestine at the same time. Feeding large quantities of barley and/or wheat is predisposing.

Blackleg is rapidly fatal. Usually the symptoms go unnoticed, the first indication of the disease being a dead, highly bloated carcass with bloody discharges oozing from the natural body openings. The symptoms, when seen, include high fever, lameness in a leg, rapid breathing, collapse followed by great reluctance or inability to get up, prostration, and death. Gas is produced that moves to the loose tissue just under the skin and can be felt as a paper-like crackling over the affected leg when firmly palpated.

Carcasses should not be opened except as decided by a veterinarian, but be deeply buried, incinerated, or removed to some place inaccessible to cattle. Discharges should be carefully scraped up and disposed of along with the carcass.

To prevent blackleg, vaccinate calves at two months of age with (1) a chauvei-septicum bacterin and (2) perfringens type D bacterin. Repeat vaccination of all young cattle a month before placement on heavy grain feed or before turning out to pasture. Perfringens type D bacterin may be obtained from veterinarians.

If animals are found alive, penicillin given by injection may be tried.

Coccidiosis. — Coccidiosis is caused by microscopic animal parasites that for practical purposes we can call coccidia. Coccidiosis is carried by healthy immune cattle. Carrier animals pass the parasites in their feces, often in extremely large numbers. Outbreaks occur most commonly in winter. Close winter quartering results in infection build-up to the point where many cattle can pick up enough parasites to cause disease.

The appearance of blood in the feces of cattle is almost always an indication of coccidiosis. In severe cases, particularly in cases of rectal coccidiosis, there is severe straining and animals may go into convulsions. Sometimes the rectum is prolapsed.

Prevention of coccidiosis is of greater value than treatment. Drying kills the parasites so that manure should be cleaned out and pens and buildings allowed to dry thoroughly before cattle are brought into winter quarters. There is no way of determining carrier animals. It is possible, nevertheless, through cleanliness, picking a location free of low spots and puddles, and good husbandry, to keep build-up to a minimum. Feeding forage off the ground where it may get contaminated should be avoided.

Treatments started after symptoms have appeared is of doubted value. It is believed that giving sulfamethazine as in shipping fever (see page 156) is beneficial. Another medicine widely used is the following:— thoroughly mix equal parts of powdered sulfur and ferrous sulfate powder; place one ounce amounts in No. 10 gelatin capsules; give one capsule per day with a balling gun for one to three days. Cases that develop convulsions may be treated by injecting a solution containing calcium and glucose into a vein or under the skin.

Brucellosis (Bang's Disease or Contagious Abortion).—Brucellosis is an infectious disease caused by a bacterial germ called **Brucella abortus.** It is a carried disease. In cattle the infection is localized. The part of the body most suitable to the germ as a place to locate and grow is the uterus. The second most suitable location is the udder. In bulls, the testicles are often affected but there is no evidence that brucellosis can be transmitted by the bull in the act of breeding.

Brucellosis is transmissible to man. Human infection, often called undulant fever, is commonly acquired by drinking raw milk from cows in which the infection has localized in the udder and

is being shed in the milk. Infection can also be acquired as a result of handling aborted calves and afterbirth from cows with the disease.

Cows with uterine infection shed the germ in genital discharges. Other animals become infected by picking up the germ with contaminated feed or water. The infection in the pregnant uterus has a tendency to cause severe damage interfering with development of the carried young. This leads very often to abortion. Abortion occurs most commonly during the seventh or eighth month of gestation, although it may occur earlier. Not all infected animals abort. Consequently caution should be exercised in purchasing additions to the herd. Such additions should be kept in isolation and blood tested before being placed in contact with the herd. The blood test is the only accurate method of diagnosis. When the infection is introduced into previously clean herds, an "abortion storm" is likely to occur in which most pregnant cows abort over the following months.

For control purposes, brucellosis has been brought under federal-provincial regulatory measures administered by veterinarians. The basis of control is the application of calfhood vaccination along with a blood testing policy. Calves must be vaccinated when four to eleven months old. It is best to vaccinate at six to eight months of age as there is less likelihood of persistent reactors to the blood test. As this is a live vaccine, great care should be exercised to avoid accidents for inoculation into man may cause undulant fever. Vaccinating and blood testing must be carried out by veterinarians. Further information can be obtained from veterinarians; from the District Veterinarian; Health of Animals Division, Regina; or from the Provincial Veterinarian, Regina.

Vibriosis.—This disease is an infection of the uterus of cows and sheath of bulls by a bacterium called **Vibrio fetus.** The infection occurs also in sheep. The disease is carried for a limited period of time by both males and females. Males acquire the infection from breeding infected females. In cattle, spread of the disease is almost exclusively by the bull. In sheep, vibriosis is able to spread among ewes by direct contact, even without the ram.

Vibriosis gives rise to abortion. In cows the abortions are so early (usually before nine weeks) that in most cases they are not observed. Sometimes abortion is later, but the calf is nearly always aborted before it has any hair. Due to the tendency to produce very early abortion, vibriosis presents the appearance of being a sterility problem rather than an abortion problem.

Vibriosis in infected animals will clear up without treatment if both cows and bulls are given sexual rest. Under ranch management, the nine months freedom from sexual intercourse provided usually enable vibriosis to clear up in both cows and bulls.

With farm cows in particular, there is urgency about getting cows in calf that does not apply in ranch management where the aim is to have all the calves born in the spring. In farm herds, natural breeding may be discontinued and artificial insemination adopted as an aid in getting around the vibriosis problem. Treatment at time of heat by placement of antibiotic drug in the uterus is an aid in getting cows in calf. Artificial insemination and placing drugs in the uterus should be left to skilled inseminators or to veterinarians.

Public pastures spread vibriosis. Clean females are placed in these pastures along with infected females, and the bulls spread the infection around. There is much need in this province for improved veterinary supervision of public pastures.

Warts.—Warts in cattle is an infectious condition caused by a virus or complex of viruses. The condition has become much more common in recent years, due in part to opportunity for spread in public pastures. Warts vary from small nodules to great tumorous masses growing from the skin.

It is highly desirable to start treatment early while the warts are still small, when they may be clipped off with scissors. If the warts are kept clipped for a time, the disease eventually disappears.

Necrobacillosis (Foot Rot, Liver Necrosis, Liver Abscess, and Calf Diphtheria).—Foot rot is a carried infectious disease caused by a bacterial germ called **Sphaerophorus necrophorus.** Formerly it was believed that the necrophorus germ thrived in soil and filth but now it appears more likely that it cannot survive apart from animal tissues for more than a few days.

In foot infections very painful lameness develops accompanied by fever, loss of appetite and loss of flesh. Infected bulls are unable to breed because of lameness.

Cattle often lick their affected feet or pick up the infection with contaminated feed. A condition may develop in the mouth called calf diphtheria. A sim-

ilar condition may develop in the throat causing difficult noisy breathing. The germ may be swallowed, and give rise to lesions in the wall of the rumen from which they are carried to the liver where they produce either liver abscesses, or very severe, highly fatal liver disease called necrotic hepatitis.

Prevention of foot rot is difficult because there is no easy way of knowing which animals are carriers. The careful trimming of the feet and application of disinfectants, such as a strong solution of bluestone, assist in controlling the infection. Foot rot can be kept to a minimum by keeping the underfooting dry so as not to soak and soften the feet. Contamination areas are sterilized of foot rot infection if cattle are excluded for a period of two weeks.

Cases of foot rot should be treated as soon as lameness is observed. Sulfapyridine is the most effective drug. Other effective drugs are sulfathiazole and sulfamethazine. Sulfamethazine is readily obtainable and may be administered as described under the treatment of shipping fever (page 156). These drugs are effective in other forms of necrobacillosis except liver abscess. In the latter, drugs used either for treatment or prevention are not effective.

Ringworm.—This is an infectious skin disease caused in cattle by a fungus called **Trichophyton verrucosum.** It is almost exclusively a winter disease in cattle crowded into close dirty quarters that are never cleaned and sanitized. In such quarters the infection lives over the summer to infect cattle year after year. Ringworm is readily spread in dairy cattle and calf club calves by currying. Characteristically the disease appears as greyish or whitish raised areas, most common around the head, that tend to grow larger and spread to other parts of the body and to other animals.

Cattle ringworm is readily transmitted to man so care should be taken when working with infected cattle.

Prevention is more effective than treatment. Quarters should be thoroughly cleaned and disinfected in the spring after cattle are put out to pasture and again in the fall before they are brought into winter quarters. Animals bought at sales, stockyards, or other places where there is possibility of exposure, should be kept isolated for at least two weeks. If cattle are curried, combs and brushes should be disinfected between animals.

The disease rapidly disappears after cattle are turned out of infested quarters onto pasture. If in the winter it has reached the stage where treatment appears necessary, it is doubtful whether the results that can be expected are worth the risk of human infection. Mineral oil, iodized mineral oil, tincture of iodine (5%), or tincture of iodine diluted with an equal volume of ether may be applied to the affected areas. Care should be taken not to get iodine into the eyes. Newer drugs that have come into use are available.

Pinkeye (Infectious Keratitis). — This is a carried, infectious disease of the eyes. The disease may be so mild that it is scarcely noticed or so severe that blindness results. Outbreaks sometimes occur in calves on pasture, but more often the disease is observed in stockyards and feedlots in the wintertime. It often occurs along with shipping fever.

Affected cattle are sensitive to light and show eye discharge. A whitish film may form over the surface of the eye. Ulcers may form. In some very severe cases, hemorrhagic inflammation of the eye ball develops that results in complete blindness. The disease is very painful and there is loss of appetite and low water intake.

Prevention is difficult because carriers cannot be detected.

Treatment is usually effective if carried out before severe damage has been done. Preparations containing sulfonamide drugs in the form of ointments, suspensions, or powders, applied to the eyes are effective.

Lump Jaw.—The cause of true lump jaw is a germ called **Actinomyces bovis.** Much more common in cattle is a chronic contagious condition in which swellings and abscesses develop around the throat and upper neck. These break periodically and discharge very thick slimy pus. The pus is infectious to other cattle. This condition is called actinobacillosis and is caused by a germ called **Actinobacillus lignieresi.** Sometimes the tongue is affected (wooden tongue). The throat may be affected with the result that difficult noisy breathing occurs. Liver abscess may develop as in necrobacillosis.

Actinobacillosis is transmissible to man and care should be taken in handling affected cattle.

In preventing lump jaw conditions, purchases of cattle with swellings about the head and throat should be avoided. Hay containing an excessively high amount of wild barley should not be fed. Lump jaw in which there is bone involvement cannot be satisfactorily

treated. Actinobacillosis responds well to iodine treatment. It is best to consult a veterinarian because in certain areas iodine treatment may cause abortion. Potassium iodide may be given. The dose is one level teaspoonful placed well back on the tongue daily for ten days. Then discontinue for ten days, and give for another ten days.

Scours in Calves, Lambs, Piglets and Newborn Animals Generally. — The cause of scours in all newborn animals (calves, pigs, lambs, etc.) is similar, being infection with colon bacillus, **Escherichia coli.**

Some strains of colon bacillus are highly pathogenic and the newborn animal sickens soon after birth and dies within twelve hours. At other times the strain of colon bacillus is less pathogenic and typical scours develop. Calves with scours may transmit the disease to healthy calves up to about one month of age.

When piglets in a litter come down with colibacillosis they promptly stop nursing. Within six hours—usually before it is realized that the piglets are sick—the sow's udder starts to harden. As a result, a mistaken diagnosis of milk fever or mastitis is frequently made in the sow.

Scours in piglets may also occur as a result of the virus disease called transmissible gastroenteritis (TGE).

Preventive measures are effective if carefully carried out. The management practiced with pregnant females should be very uniform. They should be fed according to recommendations of nutritional specialists (see page 134). Drugs should not be used in the ration of pregnant females. Changes in feed during pregnancy should be avoided or else made very gradually. Laxatives at the time of parturition should be used with discretion. Constipation can be prevented by exercise.

Parturient females should be placed in clean disinfected pens. The young animal should nurse (obtain colostrum) as soon as it can after birth—the sooner the better. Calves should be left to suck the cow for at least twenty-four hours before changing to pail feeding. Pail fed calves should be penned separately in clean pens and fed at least four times a day in small amounts out of clean, sterilized pails. This practice should be continued for at least three weeks before individuals are penned with other calves. If highly pathogenic strains of colon bacillus are in the herd, calf segregation should be continued for six to nine weeks.

Piglets should nurse as soon as born. The practice of removing the piglets one by one as they are born and waiting until the sow has finished farrowing before giving the piglets their first feeding should be avoided.

Do not administer drugs to newborn animals, but give the colon bacillus a chance to establish normally in the intestine.

Treatment of scours in new born animals is unsatisfactory. Colon bacillus readily develops resistance to drugs. The local veterinarian should be consulted because he knows best what treatment has been giving satisfactory results in the area.

Mastitis.—This is the most important disease in dairy cows. It is infectious. Many different microorganisms are capable of causing mastitis if they get into the udder, but nearly all mastitis is caused by either Streptococci or Staphylococci. Often the two organisms occur together. Infections producing mastitis invade the udder through the teat openings.

Predisposing causes are very important. Teat injuries provide entry for infection. Rough thumb and finger stripping or allowing milking machine cups to "creep" on an empty udder cause damage to the teat and lower milk cistern. Mastitis infections gain an easy foothold in these damaged tissues.

Mastitis is a complex and difficult disease to control and prevent. Owners with clean herds should exercise care not to introduce infected cows.

In the infected herd, mastitis must be lived with. Keeping the disease under control demands a continuous vigilance for early signs of the disease. Mastitis cannot be treated satisfactorily except in its early stages.

Submitting milk samples to laboratories does not produce diagnoses early enough. To obtain early diagnoses, the first three squirts of milk from every quarter should be milked through the screen of a strip cup. If blood clots or whitish flecks, flakes or masses are left on the strainer, they indicate mastitis. If a positive strip cup test is obtained, the cow should be kept in. The affected quarter or quarters should be stripped out using the strip cup at hourly or two hourly intervals for a period of six to twelve hours. If by that time the strip cup still shows positive, prompt drug treatment is indicated.

Infected cows should be placed at the end of the milking line and milked last. They should be milked by hand. Milking on the floor should be avoided. The milk

from infected quarters is not fit for human consumption and should be discarded in a safe place. The hands should be thoroughly washed in soap and water and disinfected in chlorine solution after handling infected udders.

Treatment is best left to a veterinarian. After mastitis treatment, drugs used may be shed in the milk for several days. Such milk is not fit for human consumption. The most effective drugs are penicillin and streptomycin, either singly or in combination. These and other preparations are obtainable in tubes to administer through the teat opening. Accompanying directions should be strictly followed.

Leaflets describing mastitis in more detail are obtainable from the Veterinary Science Department, University of Saskatchewan, Saskatoon.

NON-INFECTIOUS CATTLE DISEASES

Bloat.—This condition is due to accumulation of gas in the rumen (first stomach). It is a form of "indigestion" usually brought on by overeating on green pasture, particularly legume pasture, grain, frozen vegetation, etc. Bloat may develop in animals on dry feed as a result of "hardware diseases" i.e. puncture of the stomach wall by nails, pieces of wire, etc.

Unless treated promptly bloat can be rapidly fatal. Emergency treatment that can be given include drenching with one of the following: a quarter cup of turpentine shaken up in a pint of milk; two tablespoonfuls of formalin in a pint of milk; two tablespoonfuls of creolin in a quart of water, or half a cupful of coal-oil in a quart of milk. If the bloat is very severe, tapping in the left side with a trocar and cannula may be carried out. Tapping will not work in "frothy" bloat as the cannula becomes plugged with ingesta.

Milk Fever.—Milk fever is a condition that occurs at the time of calving or within a few days after. It is due to physiological failure in which the cow temporarily cannot keep enough calcium in the blood. Milk fever occurs in cows that are high producers. It is most common in cows that are five to eight years old. The animal becomes restless but soon goes down and lies quietly with its head turned to one side or else stretches out on its side. In this state the animal is unconscious. Some cases go down and remain conscious without appearing very sick. In still other cases, affected cattle show marked shivering and shaking, sweating and fighting to regain their feet.

There is no reliable means of preventing milk fever. For a few days after calving, the udder should not be milked dry, but only small amounts of milk removed.

Pumping air into the udder through the teats is effective treatment. Great care and cleanliness must be used in carrying out this operation because it may start mastitis. Injecting calcium solution under the skin or into a vein is now the treatment usually given.

Acetonemia (Ketosis).—This condition is due to inability to burn fats normally in the body. Injurious products become abundant in the system causing liver damage. Pregnancy and high milk production throw a very heavy load on the cow's system. This reaches a climax within the two months after calving which is the time that acetonemia usually occurs. The immediate cause is failure to take in food either in sufficient amounts or of adequate quality.

There are three types of the disease. The digestive type is characterized by lack of appetite, loss of flesh, loss of production, constipation and unsteady gait. The nervous type is similar with the addition of nervous symptoms such as going in circles, licking at the side of the body for prolonged periods, pressing forward in the stanchion or pressing the head against a wall. The paralytic type resembles milk fever. In all three types some, but not all persons, may notice a characteristic odor on the breath and a decidedly unpleasant flavor in the milk. Practicing veterinarians can diagnose the disorder by chemical tests.

Prevention consists in avoiding conditions resulting in insufficient nutrient intake such as poor feed, insufficient feed, unpalatable feed, indigestion, hardware disease, uterine infection, etc. Fat cows cannot be starved without risk of this disease.

Treatment is effective provided liver damage is not too extensive. Glucose (sugar) solution may be injected under the skin or into a vein. The drugs ACTH and cortison injected into muscle tissue are also effective. An attack of acetonemia predisposes to attacks at subsequent calvings. A cow that has survived two attacks should be disposed of, because a third attack often cannot be effectively treated. Treatment is best left to a veterinarian, the owner concentrating on prevention.

DISEASES OF SWINE

Virus Pneumonia.—This is the most common disease in pigs. Some recovered pigs remain carriers. Chronic coughing,

common in many herds, is a prominent symptom.

Carrier sows infect their baby pigs in the first few days of life. The piglets usually remain healthy until weaning time. A mild diarrhoea sets in at weaning, along with sneezing and coughing. A severe set-back in development occurs that lasts until the pneumonia is thrown off (a few weeks to several months). Owing to its commonness and its effect on development, virus pneumonia is the main factor responsible for inability to get pigs away to market early.

Piglets, born to a pneumonia-free sow, that come in contact with infected piglets develop the disease at ten days to three weeks of age. In such pigs the disease is more severe and deaths may occur.

There is no effective treatment and any beneficial results from the use of drugs is due to suppression of complicating infections.

The best control is to work towards a virus pneumonia-free herd. Establish suitable quarters where a few of the best sows can be individually isolated after breeding. Arrangements to provide isolation and care for single sows and their litters can often be made with neighbors who keep no pigs. After farrowing, keep the piglets isolated along with the sow. Watch for the development of virus pneumonia symptoms at weaning and save only litters and sows where no symptoms develop. By this method it is possible to replace diseased stock with clean stock within a year.

Swine Plague.—Swine plague is an acute, infectious, highly fatal disease, caused by pig strains of **Pasteurella multocida.** The disease can be carried.

Differentiating swine plague from several other pig diseases is not easy even for the veterinarian. Invariably there is severe pneumonia with difficult or laboured breathing.

To prevent the disease, vaccinate pigs after two months of age using a bacterin made from Canadian strains of the swine plague germ.

Many drugs — the sulfapyrimidines, (e.g. sulfamethazine), penicillin, streptomycin, and the tetracyclines—are effective in treating the disease.

Rhinitis.—There is much doubt about the specific cause of this disease. Carrier sows infect their piglets in the first week of life. The infection causes sneezing, snuffling, bleeding from the nose, unthriftiness, shortening of the snout, or twisting of the snout to one side, leading to a destruction of the bones in the nasal passages. Other facial bones may be affected.

The control of rhinitis is difficult because there is no way of determining carriers. It is possible to establish rhinitis-free herds by adopting the system of segregated management described under virus pneumonia (page 161). After getting the herd clean, the introduction of carriers must be avoided. Healthy animals may contract infection and become carriers if exposed to apparently healthy carriers at public sales, fairs and exhibitions. In commercial pigs, the disease can be kept to a minimum by farrowing litters in clean pens and keeping them isolated from other pigs until after weaning.

No treatment is known to be effective, and advertisements of rhinitis cures should be regarded with suspicion.

Ascariasis (Worms). — The large roundworm **Ascaris lumbricoides** var. **suis** is very common in pigs, and an important cause of unthriftiness.

Developing worms in the liver cause considerable damage marked by filmy, whitish spotting of the organ surface. Heavy migrations cause severe lung damage. The adult worms in the intestine are harmful in young pigs.

The eggs of the worm are very resistant and may remain alive for several months in soil and buildings. They are rapidly killed by exposure to direct sunlight, but are resistant to disinfectants. Boiling water or live steam is effective in disinfecting pens.

One of the best treatments is sodium fluoride mixed in dry feed at the rate of one percent and fed in dry troughs. This mixture must not be fed wet. Place water in separate troughs. Place the medicated feed before the pigs in the early morning and leave it through the daytime. Clean out the troughs in the evening. Do not leave the feed before pigs for 24 hours as poisoning may result. Avoid treating pigs suffering from other diseases as well as pregnant sows. By treating regularly every month, the production of worm eggs is stopped completely. After treating for one to two years, the worm eggs left in the soil will have died out.

Another effective drug, less poisonous than sodium fluoride, is piperazine administered in the feed at the rate of 0.296%. Starve pigs overnight. Feed the medicated ration wet or dry for 24 hours as the only feed, making sure there is ample trough space.

Oedema Disease.—This is a highly fatal, acute disease in young feeder pigs, believed to be due to absorption from the intestine of toxins produced by specific strains of colon bacillus. Affected pigs become slow moving, dull,

unsteady on their feet, and do not squeal loudly if picked up. The eyelids may be thickly swollen. Eventually they go down and die. This disease has become very widespread and common in recent years.

There are no effective preventive measures. When the disease occurs, withhold all solid food for twenty-four hours, supplying water to which has been added Epsom salts at the rate of two level tablespoonfuls per gallon, or other laxative medicine, then bring back gradually to full feed. If losses continue, add antibiotic (tetracycline drug, nitrofuran drug, etc.) to the feed for one week. Where possible a veterinarian should be consulted.

Serositis (Glasser's Disease).—This is an acute, infectious disease, chiefly of feeder pigs, which has become prevalent. The symptoms are staggering gait, pain in joints and protest if made to stand up. The staggering gait rapidly develops into a swaying incoordination in the hind quarters, eventually reaching the point where the animal cannot stand on its hind feet. Most deaths occur very suddenly, the only sign of disease being the finding of dead pigs that are blue along the back, blue along the belly with the sides white. Serositis tends to be complicated with other diseases, particularly swine erysipelas, therefore, treatment for swine erysipelas should be carried out. Means of prevention are not known.

Swine Erysipelas.—This is one of the more important infectious diseases of pigs. It is caused by a bacterium called **Erysipelothrix insidiosa.** Formerly it was believed that the germ had a reservoir in soil. However, recent studies show that a high percentage of pigs carry the germ in their tonsils and that the organism cannot survive in prairie soils for more than a week. While pigs are the principal animals infected, the germ has developed strains capable of infecting and producing disease in turkeys, sheep, man, mice, etc.

The various forms of erysipelas are arthritis, heart valve disease, diamond skin disease and acute, fatal erysipelas.

Effective safe vaccines have become available as aids in the prevention of the disease. Pigs should be vaccinated at about two months of age. Vaccinate pregnant sows a month before farrowing. Reliable vaccines can be obtained through veterinarians.

Penicillin injected into muscle tissue is effective treatment.

Anemia.—Anemia is likely to develop in young pigs as a result of iron deficiency, and it is advisable to supply some form of iron supplement (ferrous sulfate, reduced iron, injectable iron, and such). With reduced iron, place half the quantity that can be held on a dime well back on the tongue on the 2nd, 9th and 16th day. More recently injectable iron preparations have come into use and have proven satisfactory. Because of the danger of poisoning, great care should be taken not to overdose.

Mange.—Mange is a skin disease caused by tiny mites called **Sarcoptes scabiei var. suis.** The disease is transmitted by direct contact. Quarters used for infected pigs will remain infective for about two weeks.

Old animals, sows and boars, carry the mites in hard, horny lesions around the lower legs. The principal symptom is great itchiness manifested by scratching. Affected pigs are restless and lose weight. Skin scabs and scales on the upper parts develop from scratching. The skin of the ears, belly, sides of the neck, and lastly the back, become thickened, wrinkled and reddened.

Prevention and treatment go together. Clean pens and spray walls, ceiling and floor to point of run-off with a water suspension containing 0.25% lindane. Do not put lindane on the pigs. To apply to the pigs, all of which should be treated, add two pounds sulfur and eight ounces of pine tar to one gallon of linseed oil. Heat, but do not boil. Apply warm (90°-100°F.). Repeat treatment in two weeks. Used or fresh crankcase oil or crude oil, applied all over the pigs, has long been used as treatment and is very effective if repeated at weekly intervals for four weeks. Treat the lower parts of the legs of sows and boars thoroughly. Use non-heavy-duty oil.

DISEASES OF SHEEP

Enterotoxemia.—This rapidly fatal disease usually follows overeating and is caused by a toxin produced in the intestines by the bacterium **Clostridium welchii,** type D. It is often considered to be bloat. Sheep of all ages may be affected. Symptoms (seldom observed) include restlessness and lying down, inability to rise and rapid breathing with the head thrown back. After death the carcass bloats rapidly.

Perfringens Type D bacterin, obtainable from any practicing veterinarian, is very effective in preventing the disease. Vaccinate lambs at two months of age (not before). Vaccinate all lambs put in feedlots a month before placement on heavy feed irrespective of pre-

vious vaccination. Vaccinate all pregnant ewes in the last month of pregnacy.

Trichostrongylidosis (Black Scours Due to Intestinal Worms).—This condition occurs in lambs, mostly in the late summer and fall and is due to heavy infestation with small worms in the intestine. In Saskatchewan two kinds of worms are involved—**Nematodirus filicollis** and **Trichostrongylus colubri formis.**

Pastures left without sheep over winter sterilize themselves of the worms. The pastures are reinfested each spring by sheep that carry worms over winter. For severe infestation to develop, pasture build-up must occur. This is favoured by failure to worm adult sheep before putting them out to pasture in the spring, by wet conditions and by overstocking.

Symptoms produced are diarrhoea (black scours), retarded growth, loss of condition, toxic symptoms, and in severe cases—death.

The only drug worth using in treating trichostrongyidlosis is phenothiazine given in full dosage. The sheep must be weighed and drug given at the rate of 12.5 grams per 40 pounds body weight. Treat ewes and all other adult sheep forty-eight hours before placement on spring pasture with the lambs. Do not worm pregnant ewes as they will abort. The same treatment is used in lambs developing black scours. The treatment often fails in scouring lambs as the drug is passed through the intestine before it can act. In such cases repeat the treatment.

Stomach Worm Disease.—The most dangerous stomach worm is **Haemonchus contortus** as it sucks blood. Large numbers of the worms cause severe anemia in lambs, sometimes bleeding them to death.

Symptoms include unthriftiness and listlessness. The inside of the mouth and the lining of the eyelids are pale. Sometimes a swelling (bottle jaw) develops between the lower jaws.

Pre-pasture phenothiazine treatment, as for black scours, is very effective. During the summer, stomach worm build-up can be prevented by placing a phenothiazine-salt mix (phenothiazine—1.0 lbs., loose salt—9 lbs.) before the sheep instead of block salt.

Pregnancy Disease (Ketosis).—This is the same condition as acetonemia or ketosis in cows. In sheep, it occurs in advanced pregnancy, usually in ewes carrying twins or triplets. It is commonly called twin lamb disease.

The earliest symptoms are lagging behind the flock, grinding the teeth, frequent urination, trembling on exercise, and dullness. Later there is unsteady gait, weakness, inability to stand, followed by death in a few days.

For successful treatment it is necessary to be able to recognize the early symptoms. Mix water and glycerine in equal parts. Administer four ounces (half a measuring cup) by drench. Repeat treatment at twenty-four hour intervals, if necessary.

Prevention of pregnancy disease is the same as prevention of acetonemia in cows — adequate intake of quality feed. In sheep, appetite is markedly stimulated by exercise and often the only preventive measure that need be taken is to make the ewes exercise. One way to do this is to locate the feeding place about a quarter of a mile from the watering place so that the animals must walk back and forth to eat and drink.

DISINFECTING STABLES AND HENHOUSES

1. Remove manure completely from the floor and walls by a thorough scraping.
2. Sweep out thoroughly, mangers, feed racks, troughs, runways, and passages. Scrub with hot water and lye, one can of lye to five gallons of hot water. High pressure sprayers are very useful in cleaning operations.
3. Burn all scrapings and sweepings.
4. Empty and scrub individual drinking fountains with a reliable disinfectant solution.
5. Apply a heavy even coating of lime wash containing a reliable disinfectant to the floors, walls, partitions, mangers, feed racks and gutters.
6. In making lime wash, use one pound of hydrated lime per gallon of water. Add disinfectant to strength according to directions accompanying it.
7. Remove all manure, straw, bedding, and other refuse from the neighborhood of the building.
8. As it is impossible to cleanse and disinfect an earth floor, it is suggested that the top six inches of soil be removed and replaced with six inches of fresh soil from a clean source.
9. Outside yards and runways that have been occupied by diseased swine or poultry cannot be made safe by disinfection and should be left vacant for at least a year. All litter and manure should be removed so that the surface of the soil will be exposed to direct sunlight. Light surface cultivation is also advised.

10. Exposure to dryness and direct sunlight is the best disinfecting combination known. Plan housing, handling facilities and management to enable utilization of these natural germicides to maximum advantage.

COMMON HOUSEHOLD UTENSILS FOR MEASURING

1 teaspoonful=1 drachm=4 c.c.'s (mls.) approx.
1 dessertspoonful=2 drachms=8 c.c.'s approx.
1 tablespoonful=4 drachms=15 c.c.'s approx.
1 wineglassful=2 ounces (variable).
1 waterglassful=8 to 10 ounces (variable).
1 teacupful=5 to 7 ounces (variable).

APOTHECARIES' WEIGHTS

1 drachm=60 grains=4 grams approx.
1 ounce=8 drachms=480 grains=30 Grams approx.
1 pound=12 ounces=1,560 grains=375 grams approx.

TABLE FOR MAKING PERCENTAGE SOLUTIONS

1 dessertspoonful in 1 pint=1%=1 part in 100 parts.
1 tablespoonful in 1 pint=2½%=1 part in 40 parts.
2 tablespoonfuls in 1 pint=5%=1 part in 20 parts.
4 tablespoonfuls in 1 pint=10%=1 part in 10 parts.

* * *

ANT CONTROL

INDOORS

For many years, the control of ants indoors involved the use mainly of sodium fluoride in fine powder form, derris powder, and ant traps containing attractive poison baits; outdoors, fumigant materials such as carbon bisulphide, paradichlorobenzene, and calcium cyanide were generally used. Within the past few years many new insecticides have been developed. Several of these, notably DDT and chlordane, have been used successfully against ants, the latter being particularly effective. It kills quickly by contact and the spray residue remains effective, usually for several weeks, against ants travelling over treated surfaces. Many other insecticides in dust and spray form are effective in varying degree in the control of ants. Most, however, unlike chlordane, simply repel the insects and do not destroy the colony.

OUTDOORS

Chlordane in the form of dusts, wettable powders, or emulsions is recommended for the control of ant colonies outdoors. Oil-base sprays, and these include most household spray materials, are not suitable for outdoor use as they will destroy the vegetation as well as the ants. Apply emulsions or wettable powders with a water sprinkler, or a low-pressure sprayer delivering a coarse, droplet spray. Apply dusts with a dust gun.

Eight tablespoonfuls (four fluid ounces) of a 40 per cent chlodane emulsion concentrate, or four ounces by weight of chlordane wettable powder, will treat an area of 1,000 square feet of soil surface when mixed with sufficient water to give adequate coverage, usually 50 to 75 gallons. Half a pound of five per cent chlordane dust will treat a similar area. Half a pint of two per cent chlordane emulsion poured down the entrance hole to a nest, or one-eighth of a teaspoonful of 40 per cent wettable powder placed in the entrance hole and watered down, will usually destroy a colony. If a lawn, golf, or bowling green is generally infested, a thorough treatment of the entire area will produce the best results, and, if properly done, should last throughout the season. If ant nests are destroyed in the yard around a building, the ants are much less likely to enter the building. Colonies of the black carpenter ant located outdoors in verandah supports, wooden steps, and elsewhere may be controlled by the methods recommended under "Dusts" in indoor control.

Cautions

Do not permit food materials to become contaminated with chlordane, DDT, or poisoned bait mixtures.

Make sure that children and pets do not have access to poisoned baits.

If Chlordane or DDT is spilled on the skin, wash with soap and water.

Avoid contact with chlordane-treated surfaces while they are wet.

FARM MANAGEMENT

High farm output and restricted demand point to continued pressure on farming incomes. With a prospect of further rise of the general price level, farm product prices will show little gain whereas cost-good prices are likely to keep edging upwards. Individual farms, therefore, will have to keep moving in the direction of larger-volume production at lowest possible cost to maintain satisfactory incomes with the narrower operating margins. Production will be highly competitive and sensitive to market opportunities so that production plans will have to be made with a close eye to the market outlook. Producing operations will need to be geared to forcing further production gains wherever possible without excessive cost of extra inputs. Overhead costs will have to be trimmed to the minimum for well-sustained production. Careful financing will be necessary to gain essential development and expansion while keeping to sound investments and manageable financing arrangements.

Size of Business

Farm businesses which appeared adequate in size up to now are no longer so and will be even less so in the future. Many farms will need to consider further expansion as a first requirement of achieving a satisfactory income level. Based on common income and investment ratios (Table I) it usually requires a normal gross output of $12,000 to $15,000 and a farm investment value of from $50,000 to $60,000 to give a reasonably acceptable income from farming. Correspondingly higher figures apply where part of the income has to go towards rent or meeting outstanding financial obligations. Beginning operators, therefore, will need to consider carefully whether they can gain access to sufficient capital to become established successfully. Established operators should look to necessary expansion with a close view to investment values and the desirable method of expansion. Renting of extra land to increase the cropland area will offer more economy than formerly. Also, many farms for the time being may find advantage in intensive expansion through further cropping specialization or livestock development rather than in increasing the land area.

TABLE I. INCOME AND INVESTMENT RATIOS IN FARMING*

	Net income as percent of gross receipts			Farm investment value per $1,000 net income		
	Small size	Medium size	Mod. large size	Small size	Medium size	Mod. large size
	%	%	%	$	$	$
Grain Farming:						
Medium prairie	33	37	40	13,500	11,500	10,500
Medium parkland	29	33	37	18,000	15,000	13,000
Livestock Farming:						
High-return livestock	50	53	56	10,000	8,500	6,000
General livestock	43	45	47	13,000	10,500	8,500

* Medium efficiency; net income for current prices and costs, calculated as total labour and investment income (eq. of fully owned unit); investment in terms of current values.

Income gains from larger size of business flow partly from the lower operating and overhead costs allowed by larger size (Table II). Mainly, however, they result from realizing the extra net income from the extra production handled; namely, from getting about the same scale of net returns from more units. The basic consideration in attaining better size of business, therefore, is that of pushing up the number of acres or number of livestock handled through more efficient use of labor and better equipping of the farm while keeping up a fair standard of production. Progressive expansion in this form will usually give easier and quicker income gains than can be built into the farm by forcing unusually high production standards. In livestock operations, the high basic costs of livestock production put a large premium on better-than-average producing efficiency. Even for such operations, however, it will normally be preferable to concentrate on a good scale of enterprise before aiming at exceptional output levels.

TABLE II. COMPARATIVE NET INCOMES FOR FARM SIZE AND PRODUCING EFFICIENCY

Producing efficiency	Small Size			Medium Size			Large Size		
	Low	Medium	Mod. high	Low	Medium	Mod. high	Low	Medium	Mod. high
Cropping (per cult. acre)	$	$	$	$	$	$	$	$	$
Prairie:									
Low-yield soils	1.00	2.10	3.30	1.50	2.55	3.80	2.15	3.15	4.45
Medium-yield soils	2.05	3.70	5.80	2.75	4.35	6.30	3.15	4.70	6.70
High-yield soils	3.55	5.65	8.00	4.35	6.35	8.80	5.10	7.00	9.55
Parkland:									
Low-yield soils	1.20	2.45	4.90	1.90	3.05	5.60	2.75	3.80	6.45
Medium-yield soils	2.10	4.30	7.80	2.90	5.05	8.65	3.50	5.60	9.25
High-yield soils	3.00	6.50	10.10	4.30	7.70	11.40	5.45	8.75	12.55
Livestock									
Fluid milk (per cow)	85	175	260	95	185	275	105	190	285
Beef-cream (per cow)	55	105	145	60	110	150	70	120	160
Beef rearing (per cow)	27	45	68	30	50	71	35	55	73
Market hogs (per hog)	5	10	14	6	12	16	7	13	18
Commercial eggs (per hen)	0.45	0.85	1.75	0.50	0.95	1.85	0.55	1.00	1.90

Net labour and investment income (eqt. of fully owned unit); small size $6,000 gross income, medium $10,000, moderately large $15,000; livestock income based on prices relative to $1.35 wheat, calculated as livestock return with feed charged at market prices.

Crop Production

Management of cropping operations should be particularly concerned with careful application of the basic cultural and tillage practices to obtain the best possible yield results for individual cropping conditions. It should be coupled with close assessment of each element of practice to determine whether sufficient yield gains are being obtained to cover the costs of the practices concerned. For higher-cost applications such as fertilizer use, close estimate should be made of the best rate of input allowing the maximum gain in net return (Table III). Where economic yield gains are still possible with higher applications they should not be foregone because of delivery or marketing difficulties but taken together with a suitable shift of acreage to alternative crops.

TABLE III. EXAMPLE OF OPTIMUM RATE OF FERTILISER APPLICATION

Rate of fertiliser application (lbs. per acre)	Yield increase (bus. wheat)	Value of yield increase*	Cost of fertiliser application**	Added net return	Extra yield value
10	1.7	$2.04	$0.85	$1.19	$
20	3.0	3.60	1.40	2.20	1.56
30	4.0	4.80	1.95	2.85	1.20
40	4.9	5.88	2.50	3.38	1.08
50	5.7	6.84	3.05	3.79	0.96
60	6.4	7.68	3.60	4.08	0.84
70	7.0	8.40	4.15	4.25	0.72
80	7.5	9.00	4.70	4.30***	0.60***
90	7.9	9.48	5.25	4.23	0.48
100	8.1	9.72	5.80	3.92	0.24

*Yield increase at $1.20 per bus., price discounted for delay in delivery and storage costs.

** Estimated at $0.30 per acre plus 5.5 cents per pound to cover extra equipment costs and incidental costs of handling.

***Optimum application of 80 lbs. where extra yield increase (0.5 bus. at $1.20) just covers extra fertiliser cost (10 lbs. at 5.5 cents).

Crop selection.—Along with progressive yield improvement, cropping practices should aim at careful selection of crops in line with their seasonal yield and price prospects. In so far as the more common crops grown in the Province are produced with similar costs, a smaller shift in yield or price of a crop for the season means an important difference in the net return realized.

The necessary position of an alternative crop to give a net return advantage is given by:

$$\text{Necessary (Price) of alternative crop (Yield)} = \frac{\text{Expected acre-return of base crop} + \text{(extra acre-cost) of alternative crop} - \text{(lesser acre-cost)}}{\text{Expected (Price) of alternative crop (Yield)}}$$

In these terms an extra 2 to 3 cents in bushel-price or an extra 1 to 2 bushels of yield advantage can readily give a $0.50 to $1.00 per acre net income gain from choice of crop. The seasonal cropping plan, therefore, should consider the best placement of each crop in line with the soil, moisture and field conditions which will give it the maximum yield advantage. It should then select the kind of crop for each area on the basis of close comparison of the net returns which may be expected. (Chart I). The choice should not be based wholly on gross-return prospects. It should take account of indicated differences of costs between crops in terms of number and kind of operations, seed input and treatments required, and it should allow sufficient margin for higher or lower risk.

Summerfallow system.—The cropping organization of the farm also warrants close assessment of the basic cropping system in terms of the amount of summerfallow to be carried and the type of cropping furnishing the most effective rotation.

The position of summerfallow systems suggests important differences in economy of summerfallow depending on the spread between stubble and summerfallow yields and differences in summerfallowing and cropping costs. (Table IV). It supports generally greater emphasis on stubble cropping for areas and soil types which normally allow higher and surer stubble yields (Table V). It also supports a flexible summerfallow system taking advantage of narrower spreads of stubble and summerfallow yields in individual producing seasons. Account should be taken of the effect of a shift in summerfallow system on the summerfallow yield. As indicated, any reduction of summerfallow yield with change of system must be made up directly by extra yield of stubble crop.

TABLE IV. EXAMPLE COMPARISON OF SUMMERFALLOW SYSTEMS

1/2 Summerfallow System	Est. acre-costs	Expected acre-returns	1/3 Summerfallow System	Est. acre-costs	Expected acre-returns
Summerfallow	$ 5.00		Summerfallow	$ 5.00	
Summerfallow crop	7.50	(25 bu. at $1.30) 32.50	Summerfallow crop	7.50	(23 bu. at $1.30) 29.90
			Stubble crop	7.00	(... ...)
	$12.50	$32.50		$19.50	
Average per acre	$ 6.25	$16.25	Average per acre	$ 6.50	
Net to overhead		$10.00/ac.			

$$\text{Necessary stubble crop return for 1/3 system} = 3 \text{ acres} \left\{ \begin{matrix} \text{Acre-return to overhead} \\ \text{for } \tfrac{1}{2} \text{ system} \end{matrix} \right\} + \left\{ \begin{matrix} \text{Total cost of} \\ \text{1/3 system} \end{matrix} \right\} - \left\{ \begin{matrix} \text{Smf. crop return} \\ \text{for 1/3 system} \end{matrix} \right\}$$

$$= 3\ (\$10.00) + (\$19.50) - (\$29.90) = \$19.60/\text{acre or } 60\% \text{ of smf. crop value for } \tfrac{1}{2} \text{ system.}$$

General comparison of summerfallow systems (1/2, 1/3, 1/4, etc.) is given by:

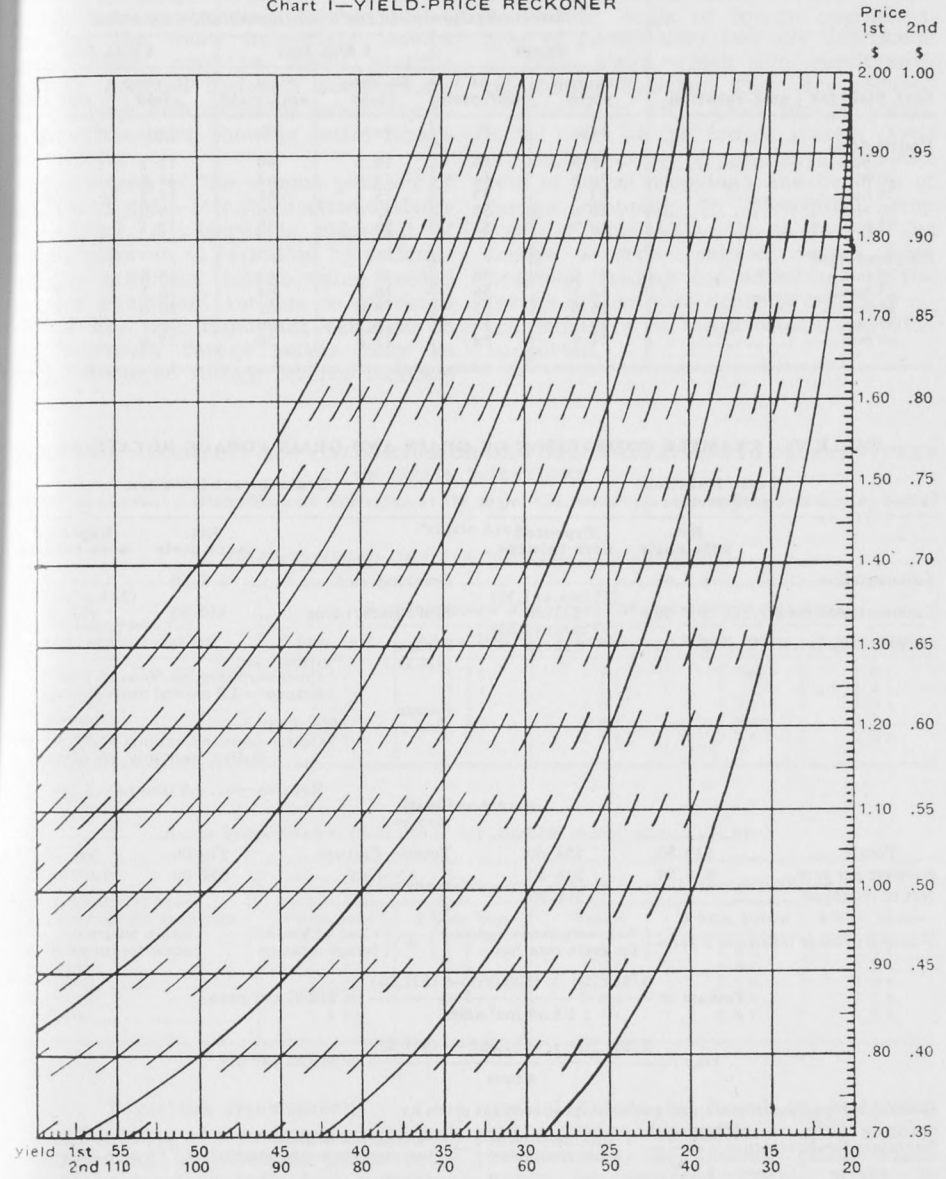
$$\text{Necessary value of stubble crop} = \frac{n_2 - n_1}{n_1} \left\{ \begin{matrix} \text{Total crop returns} \\ \text{for base system} \end{matrix} \right\} + \left\{ \begin{matrix} \text{Difference in value} \\ \text{of smf. crop} \end{matrix} \right\} + n_2 \left\{ \begin{matrix} \text{Difference in} \\ \text{per-acre cost} \end{matrix} \right\}$$

Where n_1 = length of rotation (years) for base system.

n_2 = length of rotation (years) for system compared.

$$\text{For above, } = \frac{3-2}{2} (\$32.50) + (\$2.60) + 3(0.25) = \$19.60/\text{acre.}$$

Chart I—YIELD-PRICE RECKONER



Fix the position (acre-return) of the First Crop at the point where its estimated yield line crosses the estimated price line. Following the line of the curve from this point, move along to the estimated yield for the Second Crop and read off its required price, or move along to the estimated price for the Second Crop and read off its required yield. For prices outside the given range, use a convenient ratio (⅓, ½, 2 times) and read off the yield at the same proportion. Take account of the different values of the spaces on the two scales.

TABLE V. NECESSARY STUBBLE-CROP YIELDS FOR THIRD-SUMMERFALLOW ROTATIONS TO EQUAL RETURNS OF HALF-SUMMERFALLOW ROTATIONS

(Calculated for typical summerfallowing and cropping costs)

Smf. yield for ½ smf. rotation	Summerfallow yield for 1/3 summerfallow rotation					
	Same		2 bus. less		4 bus. less	
	St. crop yield	% of ½ smf. yield	St. crop yield	% of ½ smf. yield	St. crop yield	% of ½ smf. yield
	bus.	%	bus.	%	bus.	%
Prairie Area:						
15 bus.	8.3	55	10.3	69	12.3	82
20 bus.	10.8	54	12.8	64	14.8	74
25 bus.	13.3	53	15.3	61	17.3	69
30 bus.	15.8	53	17.8	59	19.8	66
35 bus.	18.3	52	20.3	58	22.3	64
Parkland Area:						
20 bus.	11.6	58	13.6	68	15.6	78
25 bus.	14.1	56	16.1	64	18.1	72
30 bus.	16.6	55	18.6	62	20.6	69
35 bus.	19.1	55	21.1	60	23.1	66
40 bus.	21.6	54	23.6	59	25.6	64

TABLE VI. EXAMPLE COMPARISON OF GRAIN AND GRAIN-FORAGE ROTATIONS

Grain Rotation (3 years)	Est. acre-costs	Expected acre-returns
Summerfallow	$ 5.00	
Summerfallow crop	$ 7.50	(25 bus. at 1.30) $32.50
Stubble crop	$ 7.00	(17 bus. at 1.30) $22.10
Totals	$19.50	$54.60
Average per acre	$ 6.50	$18.20
Net to overhead		$11.70

Grain-forage Rotation (5 years)	Est. acre-costs	Expected acre-returns
Breaking, smf.	$ 8.50	
Smf. (nurse) crop	$10.00	(24 bus. at 1.30) $31.20
Forage (1st yr.) Pasture Use; Costs—upkeep, $0.50/acre/year. Returns—2.5 animal units grazing.		
Forage (2nd yr.) Hay Use: Costs—Mowing, raking, $2.50/ac./yr. —baling, handling, $6.50/ton. Returns—est. 4.0 tons hay/3 yrs.		
Forage (3rd yr.)		
Totals—Pasture	$20.00	$31.20
—Hay	$52.00	plus forage.

$$\text{Necessary forage return} = 5 \text{ acres} \left\{ \begin{matrix} \text{Acre-return to overhead} \\ \text{for grain rotation} \end{matrix} \right\} + \left\{ \begin{matrix} \text{Cost of grain-} \\ \text{forage rotation} \end{matrix} \right\} - \left\{ \begin{matrix} \text{Grain return of} \\ \text{grain-forage rotation} \end{matrix} \right\}$$

$$\text{Pasture} = \frac{5(\$11.70) + (\$20.00) - (\$31.20)}{2.5 \text{ animal units}} = \$18.92 \text{ per head.}$$

$$\text{Hay} = \frac{5(\$11.70) + (\$52.00) - (\$31.20)}{4 \text{ tons}} = \$19.82 \text{ per ton.}$$

General comparison of grain and grain-forage systems is given by:

$$\text{Necessary forage return} = \frac{n_2 - n_1}{n_1} \left\{ \begin{matrix} \text{Total returns of} \\ \text{grain rotation} \end{matrix} \right\} + \left\{ \begin{matrix} \text{Difference in grain} \\ \text{return between rotations} \end{matrix} \right\} + n_2 \left\{ \begin{matrix} \text{Diff. in per-} \\ \text{acre costs} \end{matrix} \right\}$$

Where n_1 = length (years) of grain rotation.

n_2 = length (years) of grain-forage rotation.

$$\text{For above—Pasture} = \frac{5-3}{3}(54.60) + (23.40) + 5(-\$2.50) = \frac{47.30}{2.5} = \$18.92 \text{ per head.}$$

$$\text{—Hay} = \frac{5-3}{3}(54.60) + (23.40) + 5(\$3.90) = \frac{79.30}{4} = \$19.82 \text{ per ton.}$$

Rotation System.—Appraisal of the rotation system should consider the possible benefit of a developed grain-forage rotation to longer-term yields in terms of effective soil-building. It should also consider the more immediate income gains which may be made possible through assisted livestock development by applying such rotations selectively to areas of the farm showing better forage adaptations.

Comparison of the income position of grain and grain-forage rotation-systems is complex. A reasonable judgment of result, however, is permitted by estimating the minimum forage value needed to give equivalent returns to overhead (Table VI). The important variables in the necessary forage return may be noted. Required forage returns increase sharply with lower forage yields (type of stand, soil and moisture condition), higher costs of the forage system (amount of summerfallow, cost of forage harvesting, scale of forage operations, kind of forage use) and any depression of grain yields which may result with the forage rotation. They are reduced substantially with good forage yields, lower costs of the forage system (type of use, reduction of summerfallow, success of nurse cropping) and benefits of forage cropping to subsequent crop yields (Table VII). In so far as the forage returns realized derive from livestock feeding the advantage of the forage system also depends critically on the efficiency of the livestock operation supported.

TABLE VII. NECESSARY HAY YIELDS FROM GRAIN-FORAGE ROTATIONS TO EQUAL RETURNS OF GRAIN ROTATIONS

(Based on current grain prices and hay value of $15.00 per ton, with typical cropping and haying costs)

Prairie Area

5 year forage rotation (Smf. Smf. (nurse) crop, three years hay).

Smf. wheat yield for 1/3 smf. grain rotation	Summerfallow wheat yield of grain-forage rotation				
	4 bus. less	2 bus. less	Same	2 bus. more	4 bus. more
15 bus.	1.4 t.	1.3 t.	1.2 t.	1.1 t.	1.0 t.
20 bus.	1.8 t.	1.7 t.	1.6 t.	1.5 t.	1.4 t.
25 bus.	2.2 t.	2.1 t.	2.0 t.	1.9 t.	1.8 t.
30 bus.	2.6 t.	2.5 t.	2.4 t.	2.3 t.	2.2 t.
35 bus.	3.0 t.	2.9 t.	2.8 t.	2.7 t.	2.6 t.

Parkland Area

6 year forage rotation (Smf., Smf. crop, Stubble (nurse) crop, 3 yrs. hay)

Smf. wheat yield for 1/3 smf. grain rotation	Summerfallow wheat yield of grain-forage rotation				
	4 bus. less	2 bus. less	Same	2 bus. more	4 bus. more
20 bus.	1.8 t.	1.7 t.	1.6 t.	1.5 t.	1.4 t.
25 bus.	2.1 t.	2.0 t.	1.9 t.	1.8 t.	1.7 t.
30 bus.	2.4 t.	2.3 t.	2.2 t.	2.1 t.	2.0 t.
35 bus.	2.6 t.	2.5 t.	2.4 t.	2.3 t.	2.2 t.
40 bus.	2.9 t.	2.8 t.	2.7 t.	2.6 t.	2.5 t.

Livestock Development

On the basis of a prospect of gradual strengthening of livestock prices relative to crop prices, individual operators should carefully assess the opportunity of adding or expanding livestock operations as means of building up the farm to full-time occupation and gaining essential expansion in the face of land shortage and high land values. The appraisal should be based on budgeting out a planned operation to give a close estimate of the income gains which might be expected (Table VIII). It should consider the best possible scale of operation and take careful account of the real feed cost involved in any necessary change in cropping organization (See Table VI).

TABLE VIII. EXAMPLE BUDGETING OF LIVESTOCK OPERATION
(Thirty-cow beef herd selling finished calves at average 825 lbs., $21.50/cwt.; estimated net calf crop 94 percent with extra allowance for animal losses of one head per year.

			Herd Total	Per Cow
Receipts:				
Animal sales—fed calves, 23 head at $177		$4070		
—cull cows, 4 head at $120		$ 480		
Manure value—7 tons/cow at $0.50		$ 105		
			$4655	$155
Feed and Bedding:				
Pasture—comm. past., quota 15 hd. at $6	$ 90			
—native past., 320 ac. at $0.60	190			
—tame past., 10 ac. at $15	150			
		$ 425		
Roughage—wild hay, 20 tons at $15	$160			
—tame hay, 40 tons at $17	680			
—straw, 20 tons at $6	120			
		$ 960		
Grain—1800 lb. /calf plus 4000 lbs. at 1.5c		685		
Suppts., salt—$5 per calf plus $2 per cow		175		
Bedding—20 tons at $6		120		
			$2365	$ 79
Return Above Feed			$2290	$ 76
Other Costs:				
Stabling, feeding eqpt.—invest., $170/cow at 7%		$ 355		
Choring eqpt., car, truck use, $3.50 per cow		105		
Misc. cash—vet., med., sprays, power, etc., $2.50/cow		75		
Sire, breeding—upkeep $80, plus net rept., $75		155		
Financing—interim loan $..... at .....%				
			$ 690	$ 22
Net to Labor and Investment			$1600	$ 53

Enterprise Organization — Organization of livestock operations should be based on specializing in the type of livestock which dovetails most effectively with the potential feed base and labor supply of the farm, and carrying to the best possible size for these conditions. It should aim specifically at full-winter scale giving an effective secondary enterprise, or at the larger scale making it the main enterprise of the farm. In the latter instance, serious consideration should be given to achieving eventual two-man scale as a way of overcoming the "tying-down" effect of livestock in one-man operation (Table IX).

TABLE IX. COMPARATIVE SIZE REQUIREMENTS OF LIVESTOCK ENTERPRISES
(Secondary winter-scale based on full winter-wage return for livestock handling; major enterprise scale related to combined return from livestock and associated feed-cropping)

	Good Secondary winter-scale			Major enterprise scale					
				One-man			Two-man		
Producing efficiency	Low	Medium	Mod. high	Low	Medium	Mod. high	Low	Medium	Mod. high
Fluid milk (cows)	20	12	—	35	20	12	55	40	30
Beef—cream (cows)	30	20	15	50	35	25	75	50	40
Beef—rearing (cows)	50	35	25	100	70	50	150	100	75
Beef—finishing (head)	225	150	100	350	250	175	500	400	275
Market hogs (hogs)	275	175	125	400	275	225	600	425	375
Comm. eggs (hens)	3000	2000	1000	——	3500	2000	——	5000	3500

Finish-feeding. — Where a low-cost basis of pasture and roughage production cannot be found on the farm, choice of secondary livestock operations is normally confined to the grain-consuming types of livestock (hogs, poultry). Consideration should also be given to possible addition of permanent finish-feeding operations, using more limited quantities of cereal hay or tame hay for roughage, or making use of available straw with adequate supplementing. Such choice should recognize the financing needs of an adequate scale of operations and the risks allied with varying price margins. In the latter respect, the operation should be planned with a close estimate of the required margin and should recognize the different margins needed under different conditions (Tables X and XI).

TABLE X. EXAMPLE ESTIMATE OF FEEDING MARGIN

Gross Feeding Return = (Gain in weight X Feeder price) + (Finished weight X Gain in price (price margin)
Gain Return Margin Return

$$\text{Required Price Margin} = \frac{\text{(Necessary Gross Feeding Return)} - \text{(Expected Gain Return)}}{\text{Finished weight}}$$

Example: 700 lb. feeder yearlings, laid-down feeder cost $0.21 cwt.; expected gain 300 lbs. — Gain Return 300 lbs. at $21 cwt. = $63.

Estimated Necessary Gross Feeding Return.		
Feed—Roughage, 0.9 ton at $16	$14	
—Grain, 1800 lbs. at 1.5c	27	
—Supplements, etc., 125 lbs. at 5c	7	
—Bedding, 1/5 ton at $6	1	$49
Feedlot, equipment, invest. $70/hd. at 7%	$ 5	
Choring equipt. use, misc. cash	3	
Margin for animal losses, 2 percent	4	
Financing—$150 at 6%, 6 mos.	5	
Desired labour and investment return	10	$27
Total		$76

$$\text{Required Price Margin} = \frac{\$76 - \$63}{\text{1,000 lbs. finished weight}} = 1.3 \text{ cents.}$$

TABLE XI. COMPARATIVE FEEDING MARGINS

(**Required price margins, with average feed inputs and costs, allowing $8 net labour and investment return per head.**)

	Calves				Yearlings			
	High Gain		Low Gain		High Gain		Low Gain	
Feeder cost	Necess. margin	Necess. selling price	Necess. margin	Necess. selling price	Necess. margin	Necess. selling price	Necess. margin	Necess. selling price
				(cents	per lb.)			
15	2.3	17.3	2.2	17.2	2.3	17.3	2.4	17.4
16	1.8	17.8	1.9	17.9	2.0	18.0	2.2	18.2
17	1.4	18.4	1.5	18.5	1.6	18.6	1.9	18.9
18	0.9	18.9	1.2	19.2	1.3	19.3	1.7	19.7
19	0.5	19.5	0.8	19.8	1.0	20.0	1.5	20.5
20	0.0	20.0	0.5	20.5	0.6	20.6	1.2	21.2
21	−0.4	20.6	0.1	20.1	0.3	21.3	1.0	22.0
22	−0.9	21.1	−0.2	21.8	0.0	22.0	0.7	22.7
23	−1.3	21.7	−0.6	22.4	−0.4	22.6	0.5	23.5
24	−1.8	22.2	−0.9	23.1	−0.7	23.3	0.3	24.3
25	−2.2	22.8	−1.3	23.7	−1.0	24.0	0.0	25.0
26	−2.7	23.3	−1.6	24.4	−1.4	24.6	−0.2	25.8
27	−3.1	23.9	−2.0	25.0	−1.7	25.3	−0.5	26.5
28	−3.6	24.4	−2.3	25.7	−2.0	26.0	−0.7	27.3
29	−4.0	25.0	−2.7	26.4	−2.3	26.7	−0.9	28.1
30	−4.5	25.5	−3.0	27.0	−2.7	27.3	−1.2	28.8

Farm Costs

Steadily rising replacement costs for equipment and improvements have carried to the point where overhead for common investments now presses excessively on returns margins. Operators should look for every possible means of trimming overhead costs in connection with future replacements and further investments. Careful selection of machines for operating and upkeep economy, close sizing of power units and machines to work loads, sacrifice of non-essential machine features, second-hand replacement, and beneficial cost-sharing and hiring arrangements should be looked to as means of reducing equipment costs. Additional attention should be given to maintenance to help defer replacement and prevent heavy lumping of replacement requirements which may present financing difficulties. Close estimates should be made of expected machine costs for individual additions and replacements and a schedule of prospective replacement needs should be kept in mind to guide replacement decisions.

Machine costs—The cost of a machine for a term of use is given by:

$$\text{Average Yearly Cost (in percent of new cost)} = \frac{\text{(Depreciation) } D + \text{(Repair) } R + \text{(Investment cost) } I}{N \text{ (number of years of use)}} + \text{(Annual maintenance and general overhead) } A$$

Where D = the percentage representing the difference between replacement cost and turn-in value;

R = the total repair cost for the term of use expressed in percent of replacement cost;

I = an investment or financing charge, commonly taken as an interest charge for the term of use on the average investment, using one-half the beginning cost plus turn-in value;

A = a yearly rate covering maintenance and servicing time, insurance, licenses and the overhead of storage, shop equipment and tools, commonly ranging from ½ to 2 percent of new cost for different machines.

Example Cost Estimates

(a) Life-use cost—Tractor run 600 hours per year for near-full life of 16 years; turn-in value estimated at 5 percent of new cost; life repair cost 60 percent of new cost; interest rate 6 percent; annual maintenance taken at 1¼ percent.

$$\text{Annual cost} = \frac{(100-5) + (60) + 16\left(\frac{6}{100}\right)\left(\frac{100+5}{2}\right)}{16} + 1\tfrac{1}{4}$$

$$= \frac{95 + 60 + 50}{16} + 1\tfrac{1}{4} = 14\tfrac{1}{4}\% \text{ of new cost.}$$

(b) Early turn-in cost—Tractor run 600 hours per year, kept 8 years, estimated turn-in value 30 percent of new cost; term repair 20 percent of new cost; interest rate 6 percent; annual maintenance 1¼ percent.

$$\text{Annual cost} = \frac{(100-30) + (20) + 8\left(\frac{6}{100}\right)\left(\frac{100+30}{2}\right)}{8} + 1\tfrac{1}{4}$$

$$= \frac{(70) + (20) + (31)}{8} + 1\tfrac{1}{4} = 16\tfrac{1}{4}\% \text{ of new cost.}$$

(c) Second-hand cost—Above 8-year-old tractor bought at 30 percent of new cost and used another 8 years at 600 hours per year; turn-in value 5 percent of new cost; remainder term repair 40 percent of new cost; interest rate 6 percent; annual maintenance 1¼ percent.

$$\text{Annual cost} = \frac{(30-5) + (40) + 8\left(\frac{6}{100}\right)\left(\frac{30+5}{2}\right)}{8} + 1\tfrac{1}{4}$$

$$= \frac{(25) + (40) + (8)}{8} + 1\tfrac{1}{4} = 10\tfrac{1}{2}\% \text{ of new cost.}$$

In the above terms, lifetime costs of machines generally range between 160 and 240 percent of new cost, with a more common range for middle use of 190 and 210 percent. Since the depreciation, investment cost and annual maintenance are more nearly fixed, cost per hour or unit of use goes up steadily as the amount of yearly use falls. (Table XII.) It goes up sharply when yearly use is not enough to exhaust most of the use-potential of a machine before it becomes obsolete. The basic approach to low-machine costs, therefore, is to adapt the sizes of machines to give an effective work load or to reduce investment by second-hand purchase or sharing and hiring arrangements.

TABLE XII. COMPARATIVE MACHINE COSTS IN RELATION TO AMOUNT OF ANNUAL USE*

Type of Machine	Low Use			Intermediate Use			Mod. High Use		
	Annual use	Annual cost	Cost per 100 hrs.	Annual use	Annual cost	Cost per 100 hrs.	Annual use	Annual cost	Cost per 100 hrs.
	(hrs.)	(% of new cost)		(hrs.)	(% of new cost)		(hrs.)	(% of new cost)	
Tractor	400	11.5	2.88	600	13.5	2.25	800	17.5	2.19
Combine	90	12.0	13.3	150	15.0	10.0	225	20.5	9.1
Heavy tillage	100	11.0	11.0	175	14.5	8.3	250	18.5	7.4
Medium tillage	75	9.5	12.7	125	12.0	9.6	200	15.5	7.8
Light tillage	50	8.0	16.0	100	10.0	10.0	150	12.0	8.0
Seeding	75	10.0	13.3	125	12.0	9.6	200	16.5	8.2
Forage	75	11.0	14.7	125	13.5	10.8	200	18.5	9.2
General outfit (incl. truck)		11.25			14.0			18.75	

* Subject to range, especially in case of tillage machines, for varying repair cost in relation to wear and tear condition.

Comparison of machine costs along the above lines relative to life-use vs. early turn-in, new vs. second-hand replacement, etc., should make due allowance for other considerations. It should leave sufficient margin for the expected difference in operating cost between an older and newer machine, and any disadvantage with respect to Income Tax allowances. It should also consider performance and needed reliability as related to the amount of use.

Overhead Investments—The requirement of keeping overhead costs low should not be translated too strictly into a maximum limit of investment without considering the position of the individual investment. In the case of equipment, however, it is normally desirable to keep total equipment overhead (depreciation, repair and investment cost) within a range of 20 to 30 percent of average yearly receipts, with the lower figure applicable to larger farms and better soils and the upper figure to smaller farms and poorer soils (Table XIII). In general this implies that the total equipment investment based on new cost should stay within an equivalent of about 1½ years of gross income for the former and 2¼ for the latter. Annual overhead cost of buildings and permanent improvements for the general farm should desirably stay below 9 to 12 percent of average receipts, suggesting an investment in terms of replacement cost inside of 1½ to 1¾ years of receipts. The overhead of livestock buildings and facilities should be kept within range of 7 to 12 percent of the respective livestock receipts, depending on kind of livestock and producing level. In these terms, investments based on new cost should generally remain below the equivalent of 1¼ to 1½ years of normal receipts for the enterprise concerned.

TABLE XIII. COMPARATIVE EQUIPMENT AND IMPROVEMENT INVESTMENTS

(Investments per acre cropland, in terms of replacement costs, representing reasonable overhead)

Farm size	Machinery and Equipment			Buildings and Improvements		
	Small size	Medium size	Large size	Small size	Medium size	Large size
Prairie Area						
Poor Soils	26	23	19	20	16	12
Medium soils	29	26	21	24	19	15
Good soils	32	28	24	27	23	19
Parkland Area						
Poor soils	30	27	23	24	20	17
Medium soils	34	31	26	28	24	20
Good soils	38	34	29	33	28	23

TABLE XIV—SUMMARY OF FARM CREDIT SOURCES

Source, Inquiry, Interest Rate	Type of Loans	Borrower Qualifications, Loaning Terms
Farm Credit Corporation (Federal Farm Credit Corporation Act) Local District Supervisor, Regional Head Office, Regina. 5 percent regular, 5½ percent on arrears, appraisal and supervision fee.	Purchases of land, implements and stock, operating supplies (fertiliser, seed); land improvements (buildings, fencing, water supplies clearing, breaking, irrigation and drainage); and discharge of liabilities for debt consolidation.	Part I—Non-supervised loans: Bona fide farmer; maximum loan at 75 percent of land held as security up to limit of $20,000; security taken as first mortgage on land; repayment term up to 30 years. Part II—Supervised loans: At least 5 years farming experience; between 21 and 45 years of age; maximum loan at 75 percent of land and chattels held as security up to limit of $27,500; security taken as first mortgage on land and chattels; repayment term up to 30 years with portion secured by chattels to be repaid in 10 years.
Co-operative Trust Company, Limited (Provincial Family Farm Credit Act) Regional Offices, Saskatoon and Regina. 6½ percent, which covers insurance on unpaid portion of loan.	Purchases of land, implements, stock; construction of buildings; repair and alterations of owned or purchased buildings; land improvements, and discharge of encumbrances against owned or purchased land.	Resident of Saskatchewan for at least three years prior to application; principal occupation farming; net value of assets not over $25,000. Maximum loan at 80 percent of value of security given, up to limit of $25,000; security taken as first mortgage on land and chattels; repayment term up to 30 years, with provision that applicants over 40 years of age must pay out before age 70; borrower must accept supervision when in default and is required to keep record of operations.
Farm Improvement Loans Act Local Bank 5 percent	Purchase of implements, breeding stock, farm electric system; land improvements (fencing, irrigation, drainage, construction, repair or alteration of buildings); in general, any item related to improvement or development of farm.	Farming as principal occupation; tenants not always eligible. Total outstanding loan at any time not to exceed $7,500, usually extended as proportion of purchase price of improvement item varying from 60 percent for second-hand implements to 90 percent for buildings; security usually taken on individual asset purchased or improved; repayment term varies with loan item (3 years for implements and up to 10 years for other items.)
Veterans' Land Act Local District Supervisor, Regional Office, Saskatoon, Regina Part I loans—3½ percent. Part III loans—5 percent.	Part I—Purchases of land, equipment, stock; erection or improvement of buildings. Part III—clearing, breaking, irrigation, draining, fencing and consolidation of debts in addition to items under Part I.	Veteran with special service requirements. Part I loans—Maximum loan of $6,000 of which not more than $1,200 can apply to equipment and stock; part of loan exists as conditional grant given after completing certain requirements; remainder repayable over 25 years. Part III loans—Loan maximum at 75 percent of security value of land, equipment and basic herd livestock, up to limit of $20,000, including outstanding portion of Part I contract; repayment term 30 years.
Credit Unions Local Association Varies with individual association—maximum of 1 percent per month on unpaid balance.	Productive and provident purposes.	Borrower must be member; amount of loan depends on available loan funds of credit union, credit standing and outstanding indebtedness of borrower; security taken on land, buildings or chattels with loanable amount governed by Credit Union bylaws.
Chartered Banks. Local Bank Usually 6 to 7 percent.	Loans usually limited to operating items for shorter term; short-term loans for purchase of land in some cases.	Loan amount at discretion of bank, depending on borrower's credit standing; usual term one to three years.
Insurance, Mortgage, Trust Companies. Variable, up to 8 percent.	Longer term loans on real estate—majority of institutions have withdrawn from lending in Saskatchewan; some loans available to better-established and more productive farms.	Loan amount at discretion of company, depending on borrower's credit rating and security value—individual contract terms.
Merchants, Dealers, Finance Companies. Local Dealers and Associated Finance Variable—effective rate often high.	Short and intermediate term credit in purchases of equipment, appliances, and operating supplies.	Often more easily obtainable than other credit by borrowers with low owner-equity; usually confined to financing balance of purchases.
Processing and Supply firms. Variable arrangements.	Advancing of feed, chicks, weanling hogs, feeders, etc.; sometimes credit for buildings and installations.	Arrangements commonly referred to as 'contract' farming; various types of contracts ranging from simple credit deal to fixed labor-payment and profit-sharing arrangements, sometimes coupled with supervision by company.

Financing and Credit

Financing assumes crucial importance in the current income situation and operators should undertake a careful inventory of their financial resources and needs to guide plans for developing the farm. Effort should be made to consolidate the position for needed cash by planning sufficient deliverable crop along with livestock and other income to meet prospective demands for cash. Every attempt should be made to get better use of available labor and facilities to build extra income sources into the farm which may add to available capital. In some cases it will warrant seeking extra employment off the farm or operating the farm on a part-time basis until it is more fully developed.

Operators should not shy away from use of suitable credit which will assist expansion or give desirable consolidation. The usual cost of credit exceeds the normal earnings rate for farm capital so that credit has to be well-employed to be beneficial. With careful use, however, operators making use of credit will be ahead because of the expansion gains which can be built into the farm. The various sources of credit which might assist farm improvement plans should be fully explored, with particular consideration of some of the newer forms of long-term credits. (Table XIV). Credit operations should be based on a careful budgeting out of the planned farm change to test the worthwhileness of the move and to guide setting up of suitable financing terms (Table XV). In some cases, a long-term credit arrangement to consolidate existing debt will make for a more manageable financing load and improve current finances. Drawing up a specific plan which sets out available finances and proposed directions of expenditure may assist both in obtaining credit and in guiding repayment arrangements.

TABLE XV. FINANCING ESTIMATORS

Annual payment required per $1,000 of original debt. (**Amortized basis**)

	Repayment terms (years)							
	5	10	15	20	25	30	35	40
4 percent	$224.63	$123.29	$ 89.94	$ 73.58	$64.01	$57.83	$53.58	$50.52
5 percent	230.97	129.50	96.34	80.24	70.95	65.05	61.07	58.28
6 percent	237.40	135.87	102.96	87.18	78.23	72.65	68.97	66.46
7 percent	243.89	142.38	109.79	94.39	85.81	80.59	77.23	75.01
8 percent	250.46	149.03	116.83	101.85	93.68	88.27	85.80	83.86

Amount of debt which can be financed per $100 annual payment. (**Amortized basis**)

4 percent	$445	$811	$1,112	$1,359	$1,562	$1,729	$1,866	$1,980
5 percent	433	772	1,038	1,246	1,409	1,537	1,637	1,716
6 percent	421	736	971	1,147	1,278	1,376	1,450	1,505
7 percent	410	702	911	1,059	1,165	1,241	1,295	1,333
8 percent	400	671	856	982	1,067	1,133	1,165	1,192

Records and Analysis

The tight income situation in prospect emphasizes the need for fuller information on present operations and generally closer estimates in making decisions on desirable operating changes. Operators should keep adequate records of production results and financial returns as an aid to management decisions. Where opportunity is available, joining the group accounting and management programs being developed under the Agricultural Representative Service and other auspices should be seriously considered. Records should be used to assess present operations to see where further production gains may be made and where savings of operating or overhead costs might be built into future operations. This should be followed up by setting out a concrete development plan for the farm for a workable term and planning out the financing of the program on a basis of a budget of expected income. In the absence of records, developing a Net Worth Statement and an estimated Income Summary along the lines indicated by the Western Farm Operator's or Saskatchewan Farm Account Books will be helpful in furnishing guides to credit and financing opportunities.

SHARE LEASES FOR SASKATCHEWAN FARMS

Crop Sharing Arrangements

General. — The standard forms of share-leases should be considered carefully in terms of their adaptation to the individual farm. Adjustment of the sharing arrangement on the basis of shifting the crop share or further division of expenses should be made to compensate for higher and lower productivity, better or poorer condition of the farm, and the type of farming carried on. Special arrangements in the form of sharing taxes or a separate cash rental may be warranted where superior facilities such as an extensive building investment or larger areas of pasture or hayland are supplied. On the other hand, a lower crop share, possibly coupled with sharing of taxes, should be considered for a farm of low productivity and with no improvements. Where the tenant is interested in special cropping or livestock operations an "offset-acre share" based on the commercial sale grain crop could be applied to the acreage in feed and special crops. Also, sharing of specialized products such as graded seed crops and breeding livestock might be based on the commercial grade price with different shares applying to the product premium. Wherever special production expenses are concerned, which benefit both landlord and tenant in terms of higher return, such as fertilizer, weed sprays, insect baits and seed treatments in cropping, feed supplements and protective materials for livestock, it will usually be desirable to share costs in the proportions in which the product is shared.

Landlord Owns Power and Equipment

Half and Half Share: This crop-share arrangement becomes unfavorable to the tenant on farms which are small or of low productivity, and in periods when yields or prices are seriously low. For such conditions the landlord is often called upon to assume an additional share of seed or the expense of equipment upkeep.

Tenant Owns Power and Equipment

Half and Half Share: Adapted to crop areas of medium or high productivity. Contains less risk for tenant than ⅓ to ⅔ share. Especially adapted where yields fluctuate widely.

One-Third - Two-Thirds: Adapted to crop areas of medium productivity in which yields are fairly stable. In more productive areas the tenant often pays a share of the taxes. For areas of lower productivity the share should preferably be adjusted to a one-fourth share to landlord, with possible sharing of taxes where productivity is intermediate.

CROP SHARE LEASES FOR GRAIN FARMS

	Landlord owns power and equipment		Tenant owns power and equipment			
	Share of crop		Share of crop		Share of crop	
	Landlord 1/2	Tenant 1/2	Landlord 1/2	Tenant 1/2	Landlord 1/3	Tenant 2/3
Investment contributions:						
Real estate	All	—	All	—	All	—
Power	All	—	—	All	—	All
Equipment	All	—	—	All	—	All
Expense contributions:						
Fire insurance	All	—	All	—	All	—
Building repairs	All	—	All	—	All	—
Fencing repairs	All	—	All	—	All	—
Taxes	All	—	All	—	All	—
Hail insurance	1/2	1/2	1/2	1/2	1/3	2/3
Seed	1/2	1/2	1/2	1/2	—	All
Twine	—	All	1/2	1/2	—	All
Threshing or combining	—	All	1/2	1/2	—	All
Board of harvest crew	—	All	1/2	1/2	—	All
Labor	—	All	—	All	—	All
Power and equipment repairs	—	All	—	All	—	All
Fuel or feed for work stock	—	All	—	All	—	All
*Other general expenses	—	All	—	All	—	All

* Expenditures for fertilizers, weed sprays and insect poisons should preferably be shared in the same proportions as the crop is shared.

COMBINED GRAIN AND LIVESTOCK SHARE LEASES

	Power, equipment and productive livestock owned half and half		Power, equipment and productive livestock all owned by landlord; tenant provides no capital	
	Share of total farm receipts and livestock increase		Share of total farm receipts and livestock increase	
	Landlord 1/2	Tenant 1/2	Landlord 1/2	Tenant 1/2
Investment contributions:				
Real estate	All	—	All	—
Power	1/2	1/2	All	—
Equipment	1/2	1/2	All	—
Productive livestock	1/2	1/2	All	—
Expense contributions:				
Fire insurance	All	—	All	—
Building repairs	All	—	All	—
Fencing repairs	All	—	All	—
Taxes	All	—	All	—
Hail insurance	1/2	1/2	1/2	1/2
Seed	1/2	1/2	1/2	1/2
Twine	1/2	1/2	—	All
Threshing or combining	1/2	1/2	—	All
Board of harvest crew	1/2	1/2	—	All
Labour	—	All	—	All
Equipment repairs	1/2	1/2	—	All
Fuel or feed for work stock	1/2	1/2	—	All
Feed for productive livestock (home grown or purchased)	1/2	1/2	1/2	1/2
*Other general expenses	1/2	1/2	—	All

* Expenditures for fertilizers, weed sprays and insect poisons should preferably be shared in the same proportions as the crop is shared.

LIVESTOCK SHARING ARRANGEMENTS

Crop-Livestock Share Leases

Where a landlord provides a herd of livestock, but where the tenant leases the cropland with his own power and equipment, the sharing of livestock receipts may be combined with the ordinary crop-sharing arrangement. If the crop lease provides for ½ and ½ shares, and if feed for livestock is set aside out of undivided crop (each party thereby providing half the feed) a half and half sharing of livestock receipts is an appropriate arrangement. If the crop share is only ⅓ to landlord, and if feed is provided from undivided crop, a ⅖ share of livestock receipts to landlord is more suitable.

Livestock Share Leases

The following are fairly satisfactory arrangements for sharing receipts from livestock where a landlord supplies a herd of foundation livestock to a tenant, who takes care of feed, housing, labor and ordinary cash expenses:

Cattle: The landlord provides a foundation herd of cows and either supplies the bull or pays the breeding fees. The tenant supplies feed and care for the herd and receives three-quarters of all sales of animals and products. Replacements to the herd are made out of normal increase. At the end of the contract period the landlord receives the equivalent, in age and number, of the animals originally supplied. Any animals above this amount are divided one-quarter to the landlord and three-quarters to the tenant. Where a superior quality of commercial herd is provided the landlord's share may reasonably be increased to a 30 percent share, while a quality breeding herd may justify higher shares of ⅓ to ⅖ of increase.

Sheep: The landlord supplies breeding females and rams and the tenant provides the feed and care of the flock. The tenant receives 60 percent of all receipts (lambs and wool) if the flock is relatively young (average four years), and ⅔ of receipts for an older flock (six years or over). Replacements to the original flock are made out of normal increase. If the flock is expanded the landlord settles with the tenant for ewes added to foundation stock according to the shares used under the lease. The landlord is responsible for replacement of breeding rams and retains all receipts from sales of breeding rams.

Hogs: The landlord supplies bred sows and the tenant supplies feed, shelter and care. The landlord receives the cash value of one average finished hog from each litter. If desired, the value of the finished hog may be stated in terms of the average market price for a given month and grade. At the end of the contract the landlord receives his sows in good market condition.

CASH RENTALS

In view of problems of delivery, storage and income settlements in present renting arrangements, and in relation to achieving more satisfactory equitability of individual rentals, serious consideration can be given to use of a cash rental as an alternative to the normal form of crop share arrangement. Such a rental may give a lower cost of leasing to the tenant, offsetting its higher risk, while at the same time giving the landlord a surer and clearer return.

Determination of a reasonable cash rental should be based on estimating a fair rental in terms of the landlord's investment and costs and comparing it with an average share rental based on a normal crop. The rental allowance would be calculated to cover taxes, the cost of upkeep and overhead for a reasonable investment of improvements serving type-of-farming needs, an investment return on the reasonable current value of the landlord's investment, the share of any production expenses to be borne by the landlord, and a margin for the landlord's supervision and administration. Taxes vary widely, ranging between 1½ to 4 percent of current land values. Building and improvement upkeep and depreciation will range from about 2 to 4 percent of current real estate value. With an investment allowance of 6 percent, the more common cash rental allowance would be in range of 8 to 10 percent of current value for a cropland parcel and 9 to 13 percent for a farm with improvements.

* * *

Crop Statistics for Grain Produced in the Prairie Provinces (D.B.S.)

Harvest Year	All Wheat	Barley	Flax	Rye	Oats	Totals
	Acreage Seeded (millions of acres)					
1958	20.2	9.4	2.6	0.4	7.6	40.2
1957	20.4	9.2	3.5	0.5	7.8	41.4
1948-57	24.0	7.7	1.5	1.0	7.6	41.8
	Average Yield per acre (bushels)					
1958	17.1	25.4	8.6	12.9	31.6	—
1957	17.8	22.7	5.5	13.8	30.0	—
1948-57	19.5	26.5	8.9	14.4	36.1	—
	Production (millions of bushels)					
1958	346.0	238.0	22.5	5.4	240.0	851.9
1957	364.0	209.0	18.9	6.3	234.0	832.2
1948-57	466.5	205.6	13.5	14.5	275.0	975.1
	Carryover* (millions of bushels)					
1958	639.4	118.2	5.6	10.1	154.9	928.2
1957	733.5	142.8	7.6	14.2	226.2	1,124.3
1948-57	355.0	81.7	4.4	12.1	105.6	558.8

*As at July 31, Canada.

WATER SUPPLY AND IRRIGATION

SURFACE STORAGE

Success in farming in Saskatchewan is largely dependent on the ability and ingenuity displayed by the farmer in making the best use of limited water resources. In addition to water stored in the soil by good tillage practices, suitable sites may be located on practically every farm for the storage of surface runoff. Under Saskatchewan climatic conditions such runoff water is generally of excellent quality. With the extension of rural electrification and improvements in pumps and motors, the attention given water from this source is rapidly increasing; at present there are four main uses for it: 1. Household. 2. Livestock. 3. Crop Spraying. 4. Irrigation.

The farmer may be guided in the preliminary study of developing the runoff on his farm by a few rules of thumb: 1. One section of land may produce up to 20 acre-feet of runoff annually. An acre-foot is a water supply one acre in size and one foot deep; it contains some 270,000 gallons. 2. The storage facilities for any definite farm requirement should be increased by 50% of such requirements to provide for evaporation and seepage losses, and for ice formation in winter. 3. A dugout 200 x 65 x 12 feet in size will store two acre-feet of water, sufficient to supply 50 head of cattle for over a year. 4. One acre-foot of water will supply all the domestic requirements of an average farm home for three years. 5. An acre-foot of water may generally provide a full irrigation for one acre of land. When the same volume is used to supplement rainfall in carrying a crop, or a garden or tree belt, over a short period of drought it may irrigate three acres.

The type and size of storage will depend upon local topography, and the use which is planned for the stored water. The most common are the dugout and the dam. A dugout 12 feet deep, 65 feet wide, and 200 feet long will store the runoff from about 65 acres of land. Where suitable sites exist small dams may be used to advantage to store larger quantities than the dugout; care must be taken that a site has sufficient banks to give a reservoir depth of at least 10 feet. Eighty per cent of Saskatchewan runoff comes from snow. Snow traps, tree belts, stubble or any obstruction to catch snow, will increase the runoff in any area; by the use of such obstructions it is possible to increase runoff as much as 100 per cent. A reservoir should be located to be free from contamination from livestock, barnyard or refuse deposits of any kind, especially if it is to be used for household purposes. The life of a reservoir may be extended by diverting from it any runoff carrying excessive silt, such as that from a finely tilled summerfallow. The grassing of runways to a reservoir and of the area surrounding it will reduce silting. Fencing a reservoir will prevent its deterioration, and will reduce the danger of drowning accidents.

Ownership of Surface Water.—All surface water is the property of the Crown; its storage and use is controlled by the Province. The Water Rights Act of the Province is designed to provide protection to water users, either for domestic, municipal, industrial, or agricultural purposes. Before actual construction is commenced on any dam or irrigation project it is necessary to apply for a **Water Right** to the Water Rights Office, Saskatchewan Department of Agriculture, Regina. A Water Right is issued subject to priority of application and beneficial use; in other words, a **Right** to use water is granted if there is an unused supply, and remains in force as long as the water covered by it is used beneficially.

IRRIGATION

The object of irrigation in Saskatchewan is to stabilize agriculture. The farm or ranch unit should have sufficient irrigation wherever practical to insure fodder for livestock, garden vegetables, seed grain, and tree belts. Even in areas with good rainfall irrigation may be used to advantage to carry growing crops through short periods of drought. The two most common types of irrigation development in the Province are individual farm projects, and community projects. The former vary in size from small plots to fields of many acres and use water from sloughs, or other natural sources, and from small reservoirs. The latter involve the organization of tracts of irrigable land into community enterprises to utilize water from the larger reservoirs or streams.

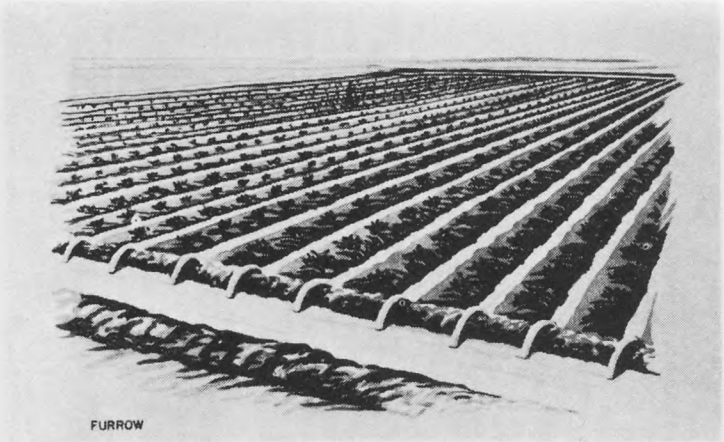
Irrigation Planning.—The suitability of the water supply and the land is the first consideration in planning an irrigation project. Both should be checked thoroughly before there is any expenditure of funds. If there is any question about either it should be discussed with one of the special Services listed herein.

If the water and soil are satisfactory, decision may be made on the most suitable system of irrigation to establish. This may be either gravity or surface, or sprinkler. Land location, topography, water supply, and cost may determine the choice. If the land is moderately level and the water supply is fully adequate, the gravity or surface method may be selected, especially if a large area is to be irrigated; on the other hand, if the land is irregular and the water supply is limited, the sprinkler system may be more suitable.

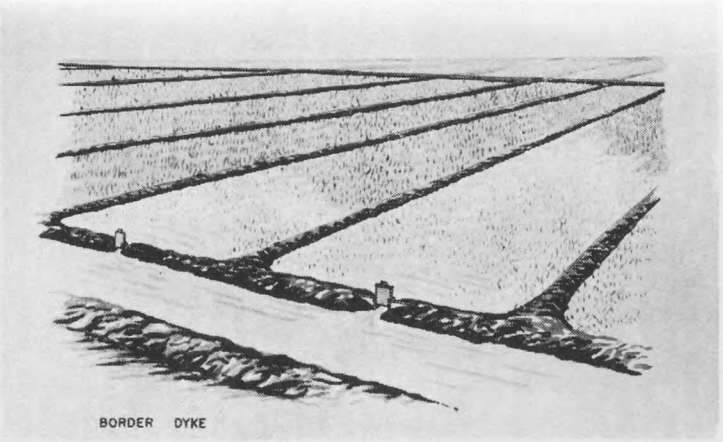
Methods of Irrigation. — There are many different methods of gravity or surface irrigation presently in use and each method is specifically adapted to its own particular set of conditions. Some of the more common methods are: 1. **Border Dyke** (often referred to as Border Strip) method of irrigation requires the least amount of irrigation labor but the most precise land preparation. The land must be levelled to definite slopes and dykes installed twenty to fifty feet apart parallel to the slope of the land to control the irrigation run. This method, where feasible, is recommended on all close-seeded crops and especially on hay and pasture fields. As only one ditch is required for each field and as the dykes themselves may be seeded down, the weed control problem is greatly reduced under this system of irrigation. 2. **Border Ditch** method is similar to the border dyke method with the dykes being replaced by ditches. This method is especially adapted to wider strips on level land. By careful placing of the ditches, water can be spread evenly over the land and following irrigation the ditches may be used for drainage. 3. The **Contour Ditch** method is used on irregular slopes and requires less land levelling. The ditches in each case run on the contour and the water is released from the ditch at intervals to achieve uniform coverage. Although this method calls for the least amount of levelling, it requires the most labor and is more difficult to operate. 4. **Furrow** method is used to distribute water between the rows of row crops. 5. The **Basin** method is used for controlling water in a series of dyked areas. 6. The **Corrugation** method of irrigation is a practice used in conjunction with many of the above methods to enable more satisfactory spreading of irrigation water. 7. The **Spring Flood** method is one of the most common irrigation practices in Saskatchewan. Using a dyke, low lying areas are backflooded during the runoff season. The water is held on the land until the frost is out of the ground and the storage capacity of the soil is filled. It is then released through control gates and frequently used on other areas. By this method not only the acreage in which the water accumulates, but also other acreages may be irrigated, either by gravity or by pumping.

The development of portable pumping units and aluminum pipe has extended the use of irrigation to many new areas. Complete portable units may be used to pump water from low areas onto crop land or summerfallow, the low area being reclaimed for crop production and the water being used in a new location. Pumping units may also be operated in association with an established irrigation system to deliver water to land above the water supply. The water may then be spread by gravity or, on land unsuitable for gravity irrigation, may be applied by the use of sprinklers. The availability of power, capital cost, and operating cost are the main factors determining the feasibility of sprinkler irrigation in any particular area. For efficient operation each sprinkler system should be designed to meet the specific characteristics of the land to be irrigated. Variations in pipe size and arrangement, are two of the important factors to be considered.

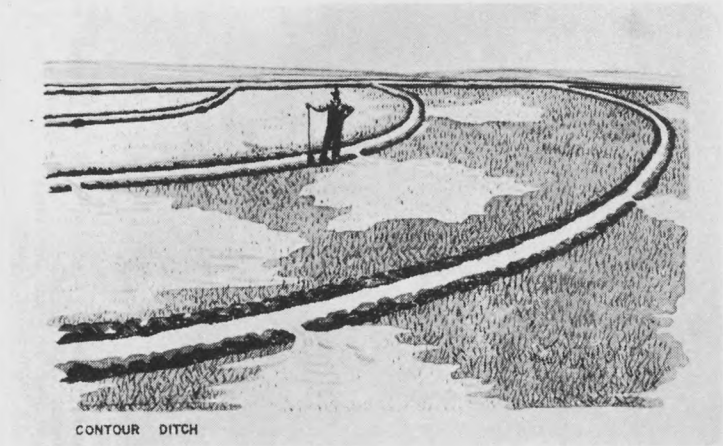
A number of **Irrigation Practices** have become generally accepted for Saskatchewan conditions; their complete use is dependent on sufficient water being available at the proper seasons. Good irrigation practice means the application of water in the right quantities at the proper time. The right quantity of water depends on the soil texture and the depth to which the soil is dry. This is the amount of water that will moisten the soil in the root zone and allow a minimum to drain through the root zone. Soil samples must be taken to determine when irrigation is needed and how much water to apply. Some method of measuring the water must be used to know how much water has been applied. Soil sampling should be done throughout the root zone, regardless of the stage of crop growth. In a newly established crop, testing is required in the surface 6 inches; sampling with a



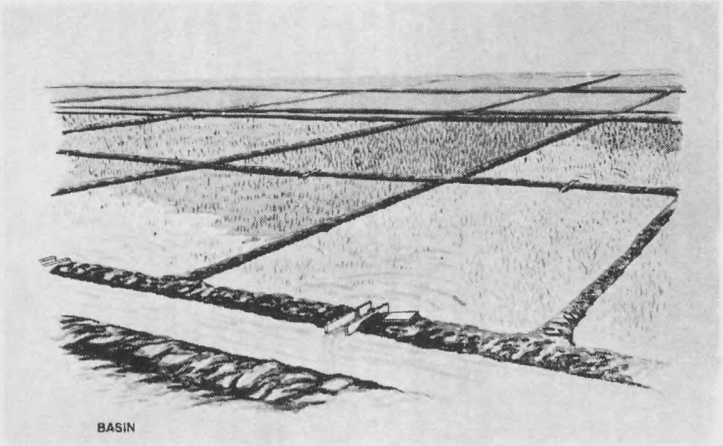
FURROW



BORDER DYKE



CONTOUR DITCH



BASIN

soil auger at greater depth will be required as the crop matures. With a little experience the irrigator can tell by feeling the soil sample the amount of water required. The "ball" test is a reasonably satisfactory method of determining water stored in the soil if no other methods are available. If the soil is dry it will not hold the ball shape (with heavy textured soils a weak ball will be formed which readily crumbles) and irrigation water should be applied at this stage. When a relatively firm ball is formed, and if on squeezing a slight film of moisture is formed on the hand, then the soil is at or near its field capacity and irrigation water need not be applied.

While soil moisture is the determining factor on time of irrigation and specific recommendations for all crops and conditions cannot be made, some general field practices are recognized in irrigating common prairie crops; (a) **Forage Crops.** Since small seedlings are shallow rooted, frequent applications of water are needed to ensure good stands, but care must be taken to avoid washing away the seed before the crop becomes well rooted. Established stands will require frequent irrigations, especially in drier seasons. Early fall irrigation is recommended to lessen the danger of winter killing. (b) **Pastures.** Pastures should be irrigated more frequently than hay fields to stimulate new growth. Higher yields will be obtained by fencing into paddocks and grazing in rotation. Stock should not be allowed to graze on pastures during or immediately after irrigation. (c) **Grain.** The value of fall irrigation to build up soil moisture reserves is emphasized. (d) **Farm Gardens.** Excellent results may be obtained irrigating gardens by gravity or sprinkler, and using any type of storage reservoir.

Precautions in Irrigation. 1. Soil Fertility.—Soil fertility and structure tend to deteriorate rapidly under irrigation; it is necessary to safeguard against this deterioration. Care must be taken to avoid soil erosion during the application of the water to the land. A crop rotation which includes forage crops should be instituted early in the cultural program. The forage crops may be utilized as green manure to provide organic matter. Barnyard manure, if available, should be used as well to maintain good soil structure and tilth. The use of legumes or manure will not be sufficient to maintain the fertility level of the soil under irrigation. Commercial fertilizer should also be used. For kinds and rates see the "Soil and Fertilizer" section of this Guide. 2. **Drainage.**—Drainage is an integral part of irrigation. Irrigation without proper drainage can, over a period of time, cause serious damage to the soil. Poor land preparation, over-irrigation and/or canal seepage constitute the main sources of drainage problems. In the planning of an irrigation project emphasis must be placed on the suitability of the soil profile for irrigation. Since some water wastage in irrigation cannot be prevented the soil profile must be capable of transmitting the excess water to natural or artificial drains. Many of the heavier subsoils common on the western prairies will not transmit water quickly enough to carry away the excess water in the periods between irrigation and should not be considered irrigable soils. Drainage of irrigated lands which involves the removal of surplus surface water and the lowering of the water table may be accomplished by: (a) Open ditch drain, which may be either shallow surface or a deep trunk drain. (b) Tile or covered drain, which is back-filled to permit field cultivation as usual. (c) The pumped well, used under special conditions. If the quality is suitable, the water may be used for further irrigation.

GROUND WATER

Ground water in sufficient quantity for farms, villages, towns and cities, and for industry, may be located in many areas of the Province. The location and development of suitable wells is frequently a problem to the individual and to the community. More definite

ESTIMATING THE AMOUNT OF WATER STORED AND AMOUNT NEEDED TO REFILL THE SOIL

Soil Texture	(Stated in inches of water per foot of soil) (A) Soil will form ball when squezed (field capacity)	(B) Soil may form weak ball (time to irrig.)	(C) Water required to restore field capacity
Sandy loam (light)	1.0	0.3	0.7
Loam—Silty loam (medium)	1.5	0.4	1.1
Clay loam—Clay (heavy)	2.0	0.6	1.4

information is now available than in earlier years as several Provincial and Federal agencies are co-operating on geological surveys with special emphasis on ground water occurrence.

Most farm wells are developed in small scattered aquifers which are deposits of glacial drift and cannot be predicted with accuracy either as to location or water production. Before digging or drilling a well the farmer should obtain any available information concerning ground water occurrence in his locality from the Water Rights office, listed in the references herein. If a driller is employed only one properly licensed under The Ground Water Conservation Act (1959) of Saskatchewan should be engaged, and a clear understanding of the conditions of the drilling contract should be set out.

REFERENCES

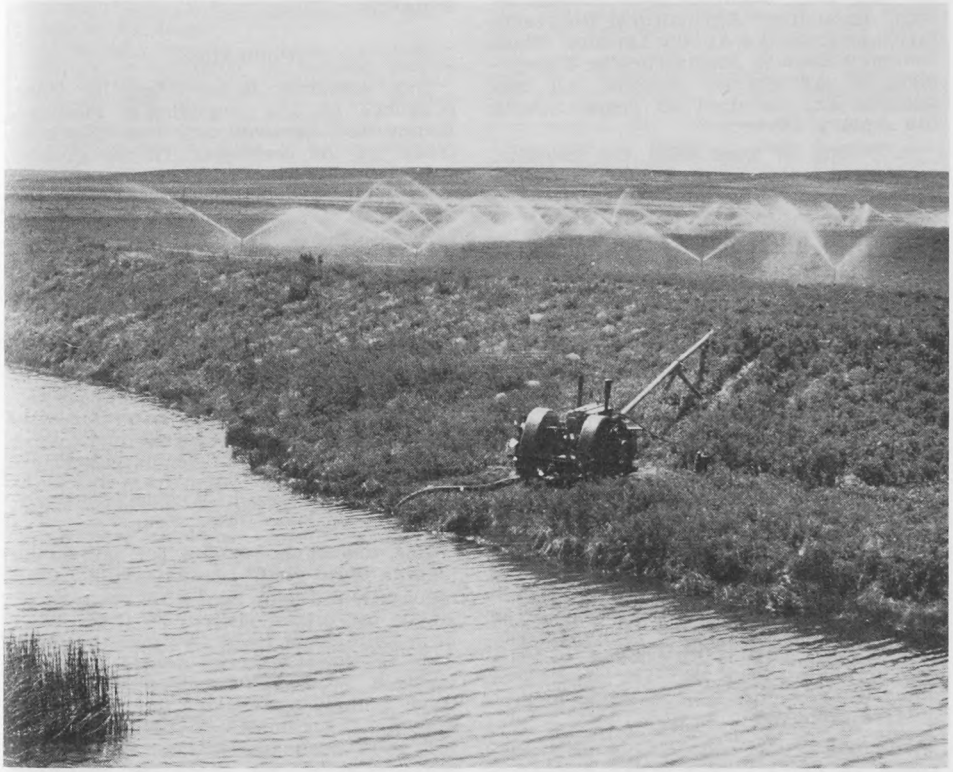
For information on Water Development, storage, analysis, and irrigation, and on engineering and financial assistance, the reader is referred to the Agricultural Representative Service of the Saskatchewan Department of Agriculture in his district, or to any of the following:

1. The Conservation and Development Branch, Saskatchewan Department of Agriculture, Regina.

2. The Experimental Farm Services, Research Branch, Canada Department of Agriculture.

3. The Prairie Farm Rehabilitation Administration, Motherwell Building, Regina, Saskatchewan.

4. The University of Saskatchewan, Saskatoon, Saskatchewan.



Pressure spray irrigation using tractor power

BEEKEEPING

Beekeeping is a fascinating occupation. Many people keep a colony of bees for pleasure rather than for profit. This desire to study and understand what goes on in the hive may constitute the best motive for starting beekeeping. If one finds he gets along well with bees and becomes intrigued by the large crops of honey his bees produce he may wish to consider honey production as a source of income.

One need not hesitate keeping bees because of the fear of being stung by them. Serious injury resulting from beestings is rare and unless one is hypersensitive to stings there is little to fear. Proper clothing, a bee veil, a smoker and confidence are the requirements for handling bees successfully.

Beginners should obtain a copy of the Bulletin, "Beekeeping in Saskatchewan" from their Agricultural Representative or from the Apiary Division, Plant Industry Branch, Saskatchewan Department of Agriculture, Regina. All beekeepers are required to register with the Apiary Division.

A colony of bees with the essential equipment costs from $20.00 to $30.00. This does not include the cost of a honey-extractor. Equipment may be purchased from a bee-supply firm, or constructed at home, or purchased from another beekeeper. When used beekeeping equipment is purchased, the buyer should ask to see the seller's "Permit to Sell", which is issued by the Apiary Division and provides a record of inspections. Beginners are advised not to purchase equipment which has a history of bee disease. Purchases of used equipment must be reported to the Apiary Division. Equipment should be assembled and ready for use before the bees arrive.

The best time to start beekeeping is in the spring when live bees may be purchased by the pound from bee-supply firms. Two pounds of bees with a queen can be shipped from California or the southern states to arrive in Saskatchewan about April 20th. Given a little care, these bees will increase in numbers quickly and will soon become a productive colony.

Honeybees are subject to few diseases. In recent years drugs and antibiotics have been used successfully to control two of the more serious brood diseases of honeybees. These are administered in the spring in a syrup made from equal parts of sugar and water. One-half teaspoonful of terramycin TM25 in a half gallon of syrup fed about May 1st and again three weeks later should afford protection to a colony against both American and European Foulbrood diseases. The Apiary Division, through the Apiaries Act, provides inspection services and assistance to beekeepers in order that bee diseases may be kept under control in Saskatchewan.

Honey sold through retail stores must be properly classified and graded by the person or firm packing the honey. These requirements are embodied in the Honey Grading Regulations under the Saskatchewan Vegetable and Honey Act. Copies of both the Apiaries Act and the Honey Grading Regulations may be obtained from the Apiary Division or from your Agriculture Representative.

Pollination

Our economy is enriched by three products of the honeybee's industry. Honey and beeswax are the "stock in trade" of the beekeeper. Of far greater value are the increased yields of seed and fruit on plants visited by the honeybee.

Honeybees purposely collect pollen to use as food. Nature has covered them with hair to which the pollen adheres. In collecting nectar and pollen the thousands of foraging bees from each colony accidentally transfer pollen from the anthers of flowers to the stigmas of other flowers thus affecting cross-pollination. Since each bee normally forages only one species of plant at a time the efficiency of bees as pollenizers is extremely high. Pollen from one plant is thus not wasted on a flower of a different species.

The use of honeybees for increasing legume seed-yields is receiving more recognition from seed-growers. Seed-yields on crops visited by bees have been as high as 10 to 15 times the seed-yield of the same crop denied the bees' services. Seed-growers usually lack the time, knowledge and inclination to manage the colonies of bees necessary for good seed production. Fortunately arrangements can often be made to have a commercial beekeeper locate his colonies in or near the crop requiring pollination. The beekeeper gets a crop of honey and the seed-grower gets increased seed-yields as a result.

Beekeepers, because of the extra labor and expense involved, are often reluctant to move their bees from a favourable location to a seed-grower's field some miles distant. Further, it is to the beekeeper's advantage to place a limited number of colonies in one location in order to obtain maximum honey-yields. When a seed-grower desires that a beekeeper move his bees and provide a large number of colonies in a field for greater seed-yields, the beekeeper may request compensation for the extra labor and extra expense involved and for the loss in honey production. A pre-arranged fee per colony payable upon delivery seems to be the best arrangement.

Two very good books on beekeeping are "The Hive and the Honeybee" edited by R. A. Grout and "The ABC and XYZ of Bee Culture" by A. I. and E. R. Root. These and other books on beekeeping may be borrowed from your public library or the Public Information Library, Administration Building, Regina.

Information on package bees and beekeeping equipment may be obtained from the Saskatchewan Beekeepers' Co-operative Association Limited, Tisdale, Saskatchewan.

KILL THE RAT

Rats are a common pest in Saskatchewan. The common kind is the Norway rat (Rattus norvegicus). It also is known as the brown, house, barn and sewer rat. This rat invades buildings, feeds on grain, meats, eggs and other food products and damages the foundations of buildings.

The Norway rat is a menace to public health. It is a carrier of bubonic plague (Black Death) which killed millions of people in Europe over the centuries. This plague is carried from rats to humans by fleas. Other diseases are harbored by rats and can be carried to man by fleas, or by contaminating food with their urine and excreta.

Rats thrive in buildings where grain and food are stored, or where refuse and garbage are dumped. They favor areas with poor buildings which provide favorable runways. They may produce six litters per year. The rat is a cunning animal and difficult to kill. To wipe out the rat, deprive him of his food and nesting places.

Civic authorities should adopt and enforce sanitary conditions. Good housekeeping is essential in any rat control campaign. Do not allow refuse and garbage to accumulate. Waste material should be kept in rat-proof metal containers. Instead of using open dumps, burn combustible garbage in efficient incinerators. Non-combustible refuse may be dumped in low lying areas and covered with at least two feet of soil to keep out rats.

Buildings should be made rat proof. Concrete is the best construction material for this purpose. Buildings should be erected on concrete foundations two feet or more above ground. Block off securely with cement holes in foundations where drain and other pipes enter. Doors and windows should fit tightly. Bind them with metal strips where rats are likely to knaw through. Wire screens over doors and windows on the basement level will help keep them out. Buildings without basements should have concrete floors next to the ground. Retaining walls two feet deep around the building also will help to prevent burrowing operations under the floor.

The best material to kill rats is poisoned bait. Warfarin is recommended. It causes painless death by internal bleeding. Corn meal or rolled oats or a mixture of these cereals is mixed with Warfarin as shown in the directions on the package. The bait is placed in runways where rats are present. Use plenty of bait and renew it at intervals. Rats do not become bait-shy with Warfarin. If possible remove other food when placing the bait. It is slow acting poison and may take about 10 days to get rid of the pests in a building. Warfarin is a relatively safe product to use. However, take care to prevent humans, pets and domestic animals from coming into contact with it.

Rats can be killed in their burrows by gassing operations. Calcium cyanide is effective but should be used only by competent operators. It should not be used indoors or near occupied buildings. The material is placed in the burrow and all openings are sealed off. Carbon monoxide is also effective for killing rats in burrows. Direct the exhaust fumes from a gas engine into the entrance of a burrow with a hose, after sealing other exits with earth. Run the engine at a moderate speed for about 10 or 15 minutes. Then seal the hole. This gas is poisonous to man and animals.

In dwellings, traps are used for killing rats where they are not numerous. Spring or guillotine type traps are recommended. Since rats avoid open spaces, placing of the trap is important. Their instinct for stealth and protection causes them to run behind any object that is placed or leaning against the wall. Set the traps behind these objects. Baits such as fresh meat, fish or cheese should be tied firmly to the trigger. Traps that held dead rats should be scalded with boiling water before using them again. New traps should be smoked or stained to give the appearance of having been used. Wear gloves when handling traps. Do not use the same bait too often. If it is untouched after 48 hours change to another bait.

Community action is desirable towards an effective rat control campaign. The Norway rat was declared a pest in Saskatchewan on July 5, 1956, under the Pest Control Act. This Act makes provision for municipalities to appoint officers who may issue orders to ratepayers dealing with rat control measures. Under the Act, municipalities may enter into an agreement for group action.

The Agricultural Representative Service

The field staff of the Agricultural Representative Service consists of 38 District Ag. Reps. They are the Extension arm of the Department of Agriculture and in their districts they represent the three major agricultural services in Saskatchewan, namely, the University of Saskatchewan, the Canada Department of Agriculture and the Saskatchewan Department of Agriculture. This is provided for through the Saskatchewan Co-operative Agricultural Extension Program which is headed by an Advisory Council.

The Advisory Council on Ag. Ext. Services consists of one representative each from the Saskatchewan Federation of Agriculture, the Saskatchewan Farmers' Union, the Saskatchewan Association of Rural Municipalities, the Saskatchewan Livestock Board, the Saskatchewan Wheat Pool, the Agricultural Societies, the Homemakers' clubs, the Chairman of District Boards, as well as representation from the University of Saskatchewan, the Canada Department of Agriculture and the four Provincial Government Departments of Agriculture, Municipal Affairs, Education and Co-operation.

Agricultural Improvement Committees have been appointed by most Rural Municipal Councils. Each Agricultural Committee attempts to plan an improvement program for the municipality. In developing this program the Agricultural Committee has the advice and counsel of the Ag. Rep.

The District Board is comprised of representatives from every municipality in an Ag. Rep. District and along with the Ag. Rep. this Board promotes an Agricultural Improvement Program on the district basis.

The objective of the Ag. Rep. Service is to institute within municipalities an Agricultural Improvement Program of better land use and good husbandry, which will lead towards greater agricultural stability.

The Ag. Rep. is ready to serve communities wishing to participate in such a program. Contact him through your Agricultural Committee man or directly at his headquarters.

District	Name	Address
1	C. C. Cooke	Box 130, Estevan
2	R. J. Brassard	Ogema
3	R. J. Christenson	Assiniboia
4	R. A. Evans	Eastend
5	J. E. Smith	Box 239, Moosomin
6	W. V. Beaulieu	Drawer "Q", Indian Head
7	A. M. Crowle	Box 1507, Weyburn
8	J. G. Braidek	69 High Street, West, Moose Jaw
9	D. H. Grant	Court House, Swift Current
10	J. I. Clark	Box 615, Maple Creek
11	D. Enns	Box 397, Leader
12	W. H. Boucher	53 Broadway East, Yorkton
13	C. G. Casswell	Melville
14	Jack McIntyre	Gov't. Administration Building, Regina
15	J. W. Kunkel	Davidson
16	G. D. Webster	E'bow
17	A. R. Domes	Kindersley
18	M. Brounstein	Kamsack
19	O. Mysak	Canora
20	L. J. Boyes	Box 580, Wynyard
21	L. M. Stalwick	Watson
22	D. J. Blackburn	Colonsay
23	D. M. Barr	Delisle
24	A. A. Kirk	Box 220, Kerrobert
25	P. W. Petersen	Hudson Bay
26	H. N. Lang	Tisdale
27	M. W. Oxman	Box 1477, Melfort
28	F. D. Miller	Wakaw
29	J. H. Maduke	311 21st Street, East, Saskatoon
30	A. J. Rugg	Box 240, Wilkie
31	B. J. Strilchuk	Box 335, Nipawin
32	M. MacKay	Land Titles Building, Prince Albert
33	Thomas Rowles	Shellbrook
34	J. F. Allan	Provincial Building, Edward St., North Battleford
35	R. E. Middleton	Maidstone
36	P. S. Saum	Box 369, Meadow Lake
37 (Far North)	J. D. Neilson	Land Titles Building, Prince Albert
38	H. R. Kingdon	Turtleford
39	A. E. W. Colton	Ft. Qu'Appelle
40	P. A. Rutherford	Rosetown

SERVICES AVAILABLE

THERE are three main sources of agricultural information and assistance available to Saskatchewan farmers. These are the University of Saskatchewan, the Saskatchewan Department of Agriculture and the Canada Department of Agriculture.

Several important services are provided by the Canada Department of Agriculture in Saskatchewan and these can be listed in three general classes:

1. Protective and regulatory service.
2. Experimental and research work.
3. Land and Water Conservation—University of Saskatchewan, Saskatoon.

Land and water conservation assistance is provided by the Prairie Farm Rehabilitation Act and includes engineering and financial assistance for the development of surface water reservoirs on farms and in rural communities as well as the provision of community pasture services.

The protective and regulatory services relate to such matters as health of animals (Animal Contagious Diseases Act), the grading and supervision of the marketing of agricultural products (The Livestock and Livestock Products Act, and other similar Acts), the regulation of the seed trade (The Seeds Act). These are listed in detail elsewhere. The administrative problems that arise in this field are either inter-provincial, national or international in their scope, which means that they should be handled by the Federal Government. Under experimental and research work are included the activities of the Experimental Farms and the research in entomology, plant pathology and forage crops at the Research Station at the University of Saskatchewan. Under development assistance would fall the work of the P.F.R.A. The Dominion also pays grants for 4-H clubs, for certain other junior activities and other features of agricultural exhibitions, for public cold storage plants and developments of a similar nature.

Provincial agricultural work falls naturally into two categories. The first one has to do with the administration of provincial laws affecting agriculture, the guidance of agricultural production policies, conducting of campaigns for the suppression of pests, and the meeting of agricultural emergencies which arise from time to time. A field staff of Agricultural Representatives (p. 188) is available for most of the work which the Department has to do in the country, and acts as a co-ordinating agency with respect to the work of the Canada Department of Agriculture and the Saskatchewan College of Agriculture under the framework of the Saskatchewan Co-operative Agricultural Extension Program.

The second aspect of provincial work, namely, education, is a primary responsibility of the University or Agricultural College.

The Agricultural Representative, for his area, is the connecting link between the farmer and all forms of assistance available.

UNIVERSITY OF SASKATCHEWAN

COLLEGE OF AGRICULTURE

Department of Animal Husbandry.
Information on farm livestock, care, feeding, management, breeding, etc.

Department of Biology—Plant Pathology Laboratory.
Information on identification and control of plant diseases.

Department of Dairy Science.
Information on care of dairy products, butter and cheese-making, care of cream separators, etc.

Department of Farm Management.
Information on farm business problems and general farm economics.

Department of Field Husbandry.
Information on farm crops, cultural practices, rotations, weed control, etc.

Department of Horticulture.
Information on vegetable gardening, fruits, flowers, horticultural pests, beekeeping, etc.

Department of Plant Ecology.
Information on weeds and weed control, identification of plants, including grasses.

Department of Poultry Husbandry.
Information on breeds, incubation, rearing, feeding, housing, etc.

Department of Soil Science.
Information on soil types, soil analysis, fertilizers, etc.

Department of Veterinary Science.
Veterinary laboratory services and information on animal diseases.

Department of Extension.

Agricultural Service
Directs the work of Agricultural and Horticultural Societies; provides judges for exhibitions and competitions; supplies speakers for short courses, farmers' meetings, and field days; organizes and directs the work of 4-H clubs, farm boys' and girls' camps and courses; distributes bulletins on farm questions; supplies specialists on specific farm questions for municipal committee and district board meetings and conferences on request of the Agricultural Representatives, and numerous other services.

Women's Service
Supervises the work of the Homemakers' Clubs and Girls' Homecraft Clubs; conducts short courses for girls and women, provides speakers for educational meetings, distributes literature on household problems, etc.

Adult Education Service
Provides courses on a variety of vocation and cultural subjects; distributes films; provides radio programs and general adult education services.

COLLEGE OF ENGINEERING

Department of Agricultural Engineering.
Information on farm power, farm machinery, lubrication, hitches, irrigation, etc.

SASKATCHEWAN DEPARTMENT OF AGRICULTURE

ADMINISTRATION

The overall administrative direction of the Department under the Deputy Minister covers personnel, policies, programs, mail, money, accounting and grants.

Statistics Division.

Provides a crop reporting service, gathers information by compilation and surveys pertaining to many phases of agricultural production. Under the Names of Homes Act records and issues certificates of the names of Saskatchewan farms.

Radio and Information Division.

Prepares and presents a radio program of farm information and current topics on radio stations each week.

Agricultural Representatives Branch.

Co-ordinates agricultural extension programs and activities within the framework of the Saskatchewan Co-operative Agricultural Extension Program on an agricultural representative district basis. The Branch assists farm people in respect to advice on the use and conservation of soil and water resources; the production of crops, livestock, poultry and bees; and sound farm management practices. District Agricultural Representatives co-ordinate the 4-H club program on a district basis. The five main divisions are Agricultural Representative field staff; Farm Mechanics; Visual Aids; Farm Management and Farm Labour.

Animal Industry Branch.

Co-ordinates the efforts in the production and marketing of livestock and livestock products. Technical personnel work through the Agricultural Representatives, the many producer organizations and the trade closely associated with them. Radio and press releases, bulletins, letters, personal and group contacts through meetings, field days and junior club work provide information to livestock producers.

Dairy Division.

Administers dairy herd improvement programs. Carries out licensing and inspection of dairy manufacturing and frozen food locker plants and administers dairy, locker plant and margarine legislation.

Live Stock Division.

Administers The Live Stock and Live Stock Products' Act, The Horned Cattle Purchases' Act, The Brand Inspection Act, The Pure Bred Sire Areas Act, The Horse Breeders' Act, and several other Acts connected with the industry.

Poultry Division.

Administers legislation regarding approval and licensing of hatcheries, egg grading stations and poultry produce firms as well as the Approved Flock Policy for poultry and turkeys.

Veterinary Division.

Administers legislation and programs designed to assist in the prevention and control of livestock and poultry diseases.

Conservation and Development Branch.

Provides administrative, agricultural and engineering services for irrigation, drainage and flood control projects on request by local organizations of affected landowners; administers The Water Rights Act, The Ground Water Conservation Act, The Conservation and Development Act, The Water Users' Act and other legislation on the use of water; administers the Saskatchewan Irrigation Policy and Flood Control Policy; reclaims crown land for forage production for hay or pasture; develops provincial community pastures for the Lands Branch, and constructs irrigation and flood control works on Department of Agricultural Projects. Irrigation works for the South Saskatchewan River Project will be administered, designed and constructed by this Branch.

Lands Branch.

Administers over 9 million acres of Crown lands in agricultural area. Lands are classified and allocated for best use, by lease agreement to farmers, or are incorporated into projects. A limited acreage is acquired by purchase, tax lien and exchange for inclusion in the various types of land utilization projects such as community pastures. The Branch operates provincial community pastures, establishes new settlement projects and finances and supervises clearing and breaking on provincial lands. A field staff of over 20 agrologists classify and appraise lands and represent the branch in field contacts with farmers concerned.

Plant Industry Branch.

Advises on seed and crop improvement, soil management, horticultural problems and weed control. It organizes programs directed toward insect control, weed control, fodder and feed grain conservation, soil management and good crop production practices. It administers provincial fodder reserves, policies relating to supply of feed and seed in emergencies and all Acts and policies relating to crop improvement and protection and marketing.

Seed Plant Division.

Custom cleaning of forage seed and registered cereals.

Apiary Division.

Advises on bee-keeping and honey production practices, administers The Apiary Inspection Act and supervises the grading of honey.

Milk Control Board.

Administers The Milk Control Act which determines prices of fluid milk sold in cities. The Board is independent and functions separately from the Department.

CANADA DEPARTMENT OF AGRICULTURE

RESEARCH BRANCH

Experimental Farms in Saskatchewan are located at Indian Head, Melfort, Scott, Swift Current and Regina.
Information concerning farm crops, tillage practices, livestock, horticulture and related subjects.

Forest Nursery Stations, Indian Head and Sutherland.
Free distribution of trees for farm shelter belts, and advice on planting and growing trees in the Prairie Provinces.

Forest Nursery Station, Indian Head.
Identification of insects affecting trees and shrubs and information on their control.

Forage Crops Section, Research Station, University of Saskatchewan, Saskatoon.
Information relating to all phases of forage crop production.

Soil Research Laboratory, Experimental Farm, Swift Current, Sask.
Information available on research work dealing with soil fertility, soil moisture and soil erosion.

Soil Survey Field Staff, Soils and Dairy Building, University of Saskatchewan, Saskatoon, Sask.
Conducting soil surveys on which information is available.

Entomology Section, Research Station, University of Saskatchewan, Saskatoon, Sask.
Identification, control, forecasts of outbreaks and information on control of insect pests.

Plant Pathology Section, Research Station, University of Saskatchewan, Saskatoon, Sask.
Identification of plant diseases and information on methods of control.

Forest Pathology Section, Research Station, University of Saskatchewan, Saskatoon, Sask.
Identification of diseases affecting trees and shrubs and information on their control.

PRODUCTION AND MARKETING BRANCH

Plant Protection Division, Post Office Building, Estevan, Sask.
Inspection of imports and exports of plants and plant products for insect pests and plant diseases, and seed potato certification.

Health of Animals Division, 828 Motherwell Building, Regina, Sask.
Assisting in preventing the introduction into Canada of destructive animal diseases and preventing the exportation of diseased livestock, or diseased or unwholesome livestock products. Control and eradication of named and transmissible diseases such as bovine tuberculosis and brucellosis. Inspection and testing of animals and poultry for export and import. Anti- and post-mortem examination of animals slaughtered for food purposes in government inspected packing plants, certification of same for inter-provincial or export trade.

Plant Products Division, 413 London Building, Saskatoon, Sask.
Enforcement of the Seeds Act, Feeding Stuffs Act, Fertilizers Act, Pest Control Products Act, Inspection and Sales Act (binder twine), and Hay and Straw Inspection Act. Inspection of pedigreed crops and seed, seed testing and seed grading. Production Reporting. Sub Offices located at Moose Jaw, Regina, Yorkton, Nipawin and Prince Albert.

Livestock Division, District Supervisor, 841 Motherwell Building, Regina, Sask.
Swine Improvement Policies—Record of Performance and Advanced Registry for Pure Bred Swine. Sow distribution and Sire Loan. Bull Loaning Policy. Record of Performance for dairy cattle and poultry. Federal Assistance to Horse Breeding. Sheep Improvement Policies.

Representatives at: Stockyards in Regina, Saskatoon, Moose Jaw and Prince Albert.
Grading of hog, beef, lamb, mutton, and veal carcasses, export bacon, and wool, as well as control of trading on stockyards. Information regarding volume of livestock sales, prices and related information.

Registration of Purebred Animals.
Correspondence concerning the registration of purebred animals of all breeds, Holstein-Friesian excepted, should be sent to The Accountant, Canadian National Livestock Records, Department of Agriculture, Ottawa; for the registration of Holstein-Friesian Cattle to the Secretary, Holstein-Friesian Association, Brantford, Ontario.

Poultry Division, 820 Motherwell Building, Regina, Sask.
Production Section—Representatives at Regina and Saskatoon. Record of Performance for Poultry; Inspection of registered hatcheries; hatchery statistics; administration of registered hatchery regulations under the Livestock and Livestock Products Act.
Marketing Section—Representatives at Regina, Saskatoon, Yorkton, Melville, and Moose Jaw. Grading and inspection of shell eggs, frozen eggs, dressed and eviscerated poultry; market information; administration of regulations carried on under authority of the Canada Agricultural Products Standards Act.
The Poultry Division is also the operating medium for the Agricultural Stabilization Board insofar as poultry products are concerned.

Dairy Products Division, Representatives at 811 Motherwell Building, Regina, Sask., 319 Federal Building, Saskatoon and 113 Federal Building, Yorkton.
Grading and inspection of Dairy Products.

Fruit and Vegetable Division, Representatives at 819 Motherwell Building, Regina, and London Building, Saskatoon.
Inspection services under the Fruit, Vegetable and Honey Act, Honey Grading and Inspection Regulations under the Saskatchewan Vegetable and Honey Sales Act. Market information.

Consolidated Retail Inspection Unit, Representatives at: 815 Motherwell Building, Regina, Sask.
Inspection of Fruits, Vegetables, Canned Goods, Meat, Dairy Products, Poultry Products, Honey in retail outlets.

ADMINISTRATION BRANCH

Economics Division, Research Station, University Sub Post Office, Saskatoon, Sask.

Research work is conducted in land utilization, farm management and marketing of agricultural products. Information pertaining to studies made is available on request.

SPECIAL ACT ADMINISTRATIONS

Prairie Farm Rehabilitation Administration, 4th Floor, Motherwell Bldg., Regina, Sask.

Administers the Prairie Farm Rehabilitation Act and special votes of Parliament concerned with the soil and water conservation, irrigation and land utilization in Western Canada.

Under the P.F.R.A. Water Development Program, agricultural, engineering, and financial assistance is made available to farmers for the construction of individual farm, community and large water storage and irrigation projects within the P.F.R.A. area of the three prairie provinces. Supervision of these services in Saskatchewan is handled through the P.F.R.A. Head Office in Regina, and district offices located at Melville, Weyburn, Moose Jaw, Gravelbourg, Shaunavon, Biggar and Swift Current.

The P.F.R.A. Land Utilization Program which mainly involves the construction, organization and operation of Community Pastures in Saskatchewan and Manitoba is administered from P.F.R.A. headquarters in Regina and district offices located at Weyburn, Saskatoon and Swift Current in Saskatchewan.

The construction of major irrigation and reclamation projects is administered from P.F.R.A. headquarters in Regina and regional and project offices are Saskatchewan: located at Regina, South Saskatchewan River Damsite, Saskatoon and Swift Current.

Prairie Farm Assistance Administration, 418 Federal Building, Regina, Sask.

Provision for benefit payments to farmers having low crop yields because of drought, insect damage and other causes.

THE AGRICULTURAL MACHINERY ACT

To serve Saskatchewan farmers by attempting to improve the availability of repair parts and service facilities for farm machinery. This administration provides an investigational service into complaints arising out of the sale and operation of farm implements. It provides publicity service to farm people with regard to their prerogatives and remedies under The Saskatchewan Agricultural Machinery Act in the purchasing of new farm equipment.

Testing Branch.

It provides services in testing and performance evaluation, both structurally and functionally, of farm machinery offered for sale in the Province. It provides published reports available to all farm people within the Province on the tests undertaken on each individual machine.

It advises on the performance characteristics of machines so that farm people will have available more pertinent performance information on machines and their relation to the actual job required of them.

The Branch also provides for the testing of prototype machines on a fee basis thus assisting farm people in getting a more suitable machine manufactured and marketed by farm machinery manufacturers.

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MORE detailed information than that given in the Guide is freely available on request. Enquiries concerning problems of agricultural production and general management should be addressed to the nearest Agricultural Representative Office (see page 189) or to the University of Saskatchewan, Saskatoon, or to the Federal Experimental Farm at Indian Head, Melfort, Regina, Scott or Swift Current. Enquiries regarding laws and regulations affecting agriculture should be sent to the Saskatchewan Department of Agriculture, Regina, or in the case of Federal Services, to the particular office indicated in the list given on pages 191 and 192. Letters relating to special problems, such as plant diseases, insect pests, etc., should be sent to the addresses indicated in the corresponding sections of the Guide. All are co-operating in the endeavor to give the farmer the best information and service possible, and letters—or personal visits where possible—in regard to individual problems will be welcomed by agricultural workers.